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Iris Recognition and Automated Eye Tracking

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Abstract — *Physiological and behavioral characteristics of individuals that distinguish one person from the others. These characteristics are different in each person Iris is the best characteristic that can be used for person's identification and authentication in comparison with fingerprints, face, voice, and signature. The iris pattern is different between the right and left eye of the same person. For this recognition system we have used MATLAB tool. For iris recognition first of all database will be created in MATLAB using webcam. Then iris localization is done, for iris identification. After localization normalization and segmentation will performed, for that hough transform algorithm implemented. In last binarization of image is performed. Then binary output is compared with database image's binary value. From comparison recognition is done, we can identify whether person is authorized or not.*

Keywords- *Iris pattern, MATLAB, iris localization, normalization, segmentation, hough transform, binarization.*

I. INTRODUCTION

With the increasing demands of security in our daily life, personal identification based on biometrics has become an emerging alternative for security applications. Biometrics is a science that involves the statistics related to biological characteristics. Biometrics is used in for analysing human characteristics and recognition for security, machine vision, and ease of work. Biometric can be physical or behavioural. Physical biometric are retina vessel, fingerprint, eye, face, hand and voice Iris detection and localization is important stage of iris recognition systems and few eye-based applications i.e. drowsy driver alert system and face orientation system. Output of the iris detection and localization stage is input to the recognition stage. It plays important role in overall system performance and success rate. This stage solves the problem of how to choose a clear and well-focused iris image. Without placing undue constraints on the human operator/user, image acquisition of the iris cannot be expected to yield an image containing only the iris.

II. IRIS RECOGNITION SYSTEM

2.1 Structure for Biometric Identification System

Iris recognition system has the same features as a pattern recognition system. It consists of biometric reader (sensor), pattern extractor to extract the features of the biometric identifier and features matcher for comparing two biometric identifiers (identification). A model of the system is shown figure below:

This kind of systems consists of the enrollment and authentication subsystems. At the stage of enrollment, images captured from the iris of each user and using the feature extractors to extract the features of the iris and create the iris pattern. Then the iris pattern is stored to a database for future use. In the stage of identification, the system captures an image from the user and using the same feature extractors routines used in the enrollment, extracts the iris pattern. Then search the entire database for matches using the extracted iris pattern. If a match found then the user is granted access otherwise access is denied. The enrollment and identification *subsystems* use the same procedures.

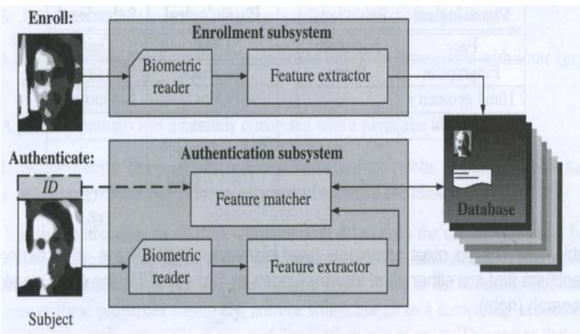


Fig 1: Typical Structure for Biometric Identification System

2.2 Working methodology

In below figure flow diagram of system is shown. First of image of iris is taken. That image is stored in matlab database. Then Image Acquisition is done in that snapshot is taken from object. Then image localization and normalization is done. After that binarization of image is carried. Then finally identification is done by comparison with database. Result is taken whether the person is authenticated or not.
For the acquisition of iris recognition system, a web-camera used mounted to a fixed stand. The step of the image acquisition is very critical to the system because the better quality of image can be acquire the better results will have during the feature extraction procedure

The transform is implemented by quantizing the Hough parameter space into (r,θ)finite intervals or Taccumulator cellsT. As the algorithm runs( ) i i x , y , each is transformed into a discredited (r,θ)curve and the accumulator cells which lie along this curve are incremented. Resulting peaks in the accumulator array represent strong evidence that a corresponding straight line exists in the image.
We can use this same procedure to detect other features with analytical descriptions. For instance, in the case of TcirclesT, the parametric equation is $(x-a)^2 + (y-b)^2 = r^2$ where a,b are the coordinates of the center of the circle and r is the radiusT

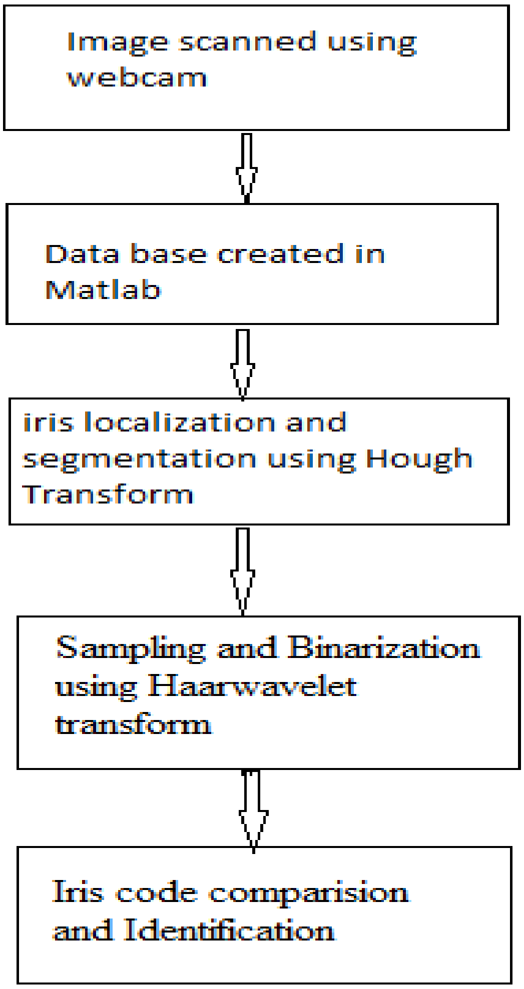


Fig 2: Working block Diagram

In this procedure, the aim is to locate the boundaries of the iris and the pupil. Then knowing exactly where the iris, the extraction of the iris pattern is simplified. This procedure is essential particularly on automated recognition systems. In the same time, the iris and the pupil have circular shape. Thus we use the Hough Transform to find circular shapes. “The Hough transform is a technique which can be used to isolate features of a particular shape within an image. Because it requires that the desired features be specified in some parametric form, the TclassicalT Hough transform is most commonly used for the detection of regular curves such as lines, circles, ellipses, Tetc. A generalized Hough transform can be employed in applications where a simple analytic description of a feature(s) is not possible.

At this step of process the boundaries of the iris and pupil are defined. Thus we can apply the feature extractors. The iris should be unwrapped in order to sampled and derive the information signal which will be used to create the template of the iris into binary form.

Comparison of IrisCode records includes calculation of a Hamming Distance (HD), as a measure of variation between the IrisCode record from the presented iris and each IrisCode record in the database. Each use able pair of the 2048 available pairs of bits is compared (Figure 3), and a value assigned using exclusive-OR logic. (The total 2048 pairs are seldom compared in their entirety, because of the field optimization process described above.) Bit #1 from the presented IrisCode record is compared to bit #1 from the reference IrisCode record, bit #2 from the presented IrisCode record is compared to bit #2 from the reference IrisCode record, and so on. If two bits are alike, the system assigns a value of zero to that pair comparison.

III. RESULT

We simulated different stages of iris recognition discussed above in MATLAB 7.10.0. results obtained from different stages are as follows:

Iris segmentation is a critical step in an iris recognition system. It is to isolate the actual iris area from the human eye image. These steps after segmentation (involving normalization, enhancement, feature extraction and matching) are based on the results of iris segmentation. The performance of iris recognition system is mainly dependent on the accuracy of iris segmentation**.**

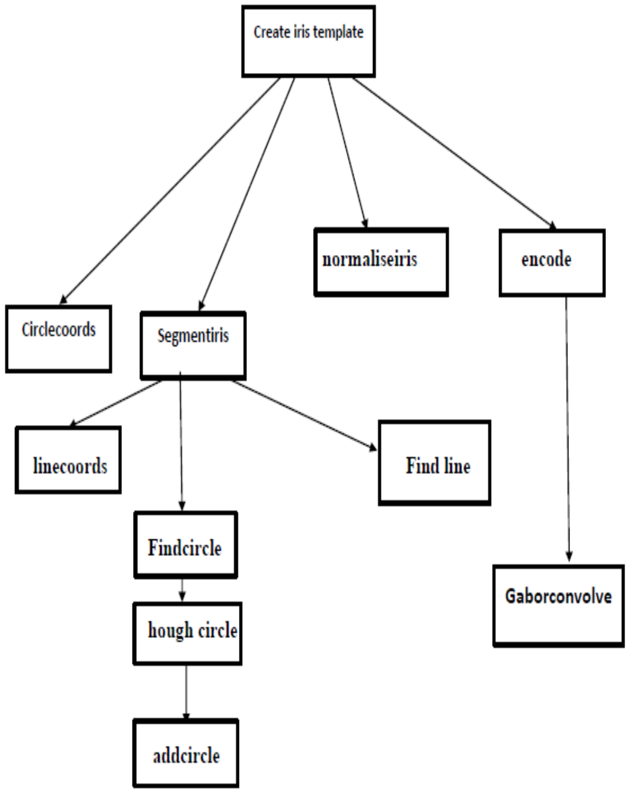


Fig 3 System Implementation

In above figure full system block diagram is shown first of iris template is created. Then iris localization and segmentation is implemented hough transform. After that iris normalization is done. For encoding of iris code gabor transform is used

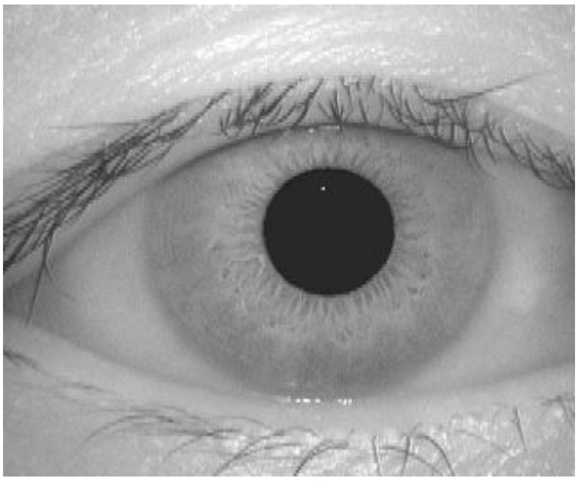


Fig 4 : original input image

A. *Segmented output*

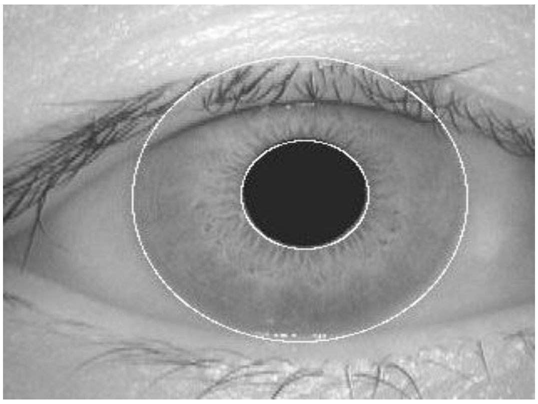


Fig 5: segmented output of iris.

B. *Iris Normalization*

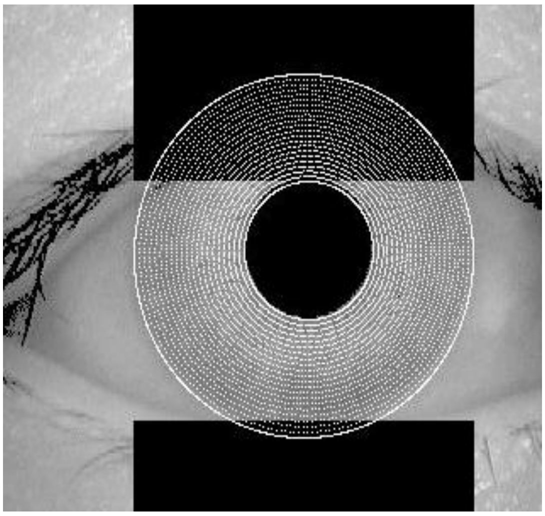


Fig 6: Normalization of iris

C. Segmented output with noise

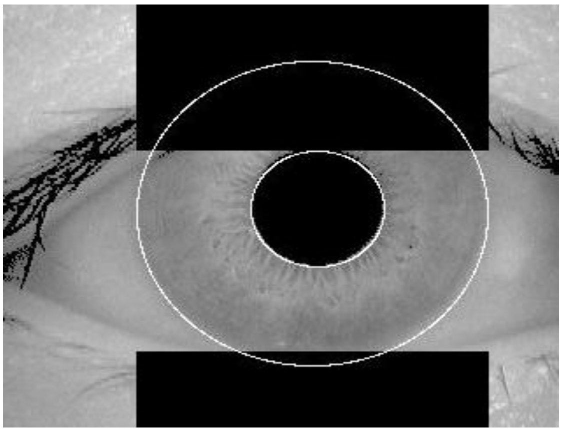


Fig 7: segmented output of iris with noise.

IV. MATCHING AND HAMMING DISTANCE

The encoding process produces a bitwise template containing a number of bits of information, and a corresponding noise mask which corresponds to corrupt areas within the iris pattern, and marks bits in the template as corrupt. Since the phase information will be meaningless at regions where the amplitude is zero, these regions are also marked in the noise mask. The total number of bits in the template will be the angular resolution times the radial resolution, times 2, times the number of filters used.

For matching, the Hamming distance was chosen as a metric for recognition, since bit-wise comparisons were necessary. The Hamming distance algorithm employed also incorporates noise masking, so that only significant bits are used in calculating the Hamming distance between two iris templates. Now when taking the Hamming distance, only those bits in the iris pattern that correspond to '0' bits in noise masks of both iris patterns will be used in the calculation. The Hamming distance will be calculated using only the bits generated from the true iris region, and this modified Hamming distance formula is given as

$$HD = \frac{1}{N - \sum_{k=1}^{N} Xn_k (OR) Yn_k} \sum_{j=1}^{N} X_j (XOR) Y_j (AND) Xn'_j (AND) Yn'_j$$

where Xj and Yj are the two bit-wise templates to compare, Xnj and Ynj are the corresponding noise masks for Xj and Yj, and N is the number of bits represented by each template

Comparison of IrisCode records includes calculation of a Hamming Distance (HD), as a measure of variation between the IrisCode record from the presented iris and each IrisCode record in the database. Each use able pair of the 2048 available pairs of bits is compared, and a value assigned using exclusive-OR logic. (The total 2048 pairs are seldom compared in their entirety, because of the field optimization process described above.) Bit #1 from the presented IrisCode record is compared to bit #1 from the reference IrisCode record, bit #2 from the presented IrisCode record is compared to bit #2 from the reference IrisCode record, and so on. If two bits are alike, the system assigns a value of zero to that pair comparison

After binarization hamming distance is calculated between user iris data and iris data stored in database. If two bits are different, the system assigns a value of one to that pair comparison. After all pairs are compared, the number of disagreeing bit-pairs is divided by the total number of bit-pair comparisons resulting in a two digit quantitative expression of how different the two IrisCode records are. A Hamming Distance of .10 means that two IrisCode records differed by 10%.

In order to account for rotational inconsistencies, when the Hamming distance of two templates is calculated, one template is shifted left and right bit-wise and a number of Hamming distance values are calculated from successive shifts. This bit-wise shifting in the horizontal direction corresponds to rotation of the original iris region by an angle given by the angular resolution used. If an angular resolution of 180 is used, each shift will correspond to a rotation of 2 degrees in the iris region. This method is suggested by Daugman [1], and corrects for misalignments in the normalised iris pattern caused by rotational differences during imaging. From the calculated Hamming distance values, only the lowest is taken, since this corresponds to the best match between two templates.

The number of bits moved during each shift is given by two times the number of filters used, since each filter will generate two bits of information from one pixel of the normalised region. The actual number of shifts required to normalise rotational inconsistencies will be determined by the maximum angle difference between two images of the same eye, and one shift is defined as one shift to the left, followed by one shift to the right. The shifting process for one shift is illustrated in Figure.

One shift is defined as one shift left, and one shift right of a reference template. In this example one filter is used to encode the templates, so only two bits are moved during a shift. The lowest Hamming distance, in this case zero, is then used since this corresponds to the best match between the two templates.

We have taken different iris samples of same person and calculated hamming distance between them, Hamming distance is varied between 0.21 to 0.25.

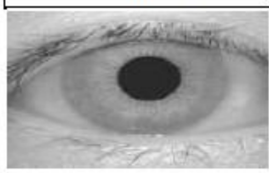
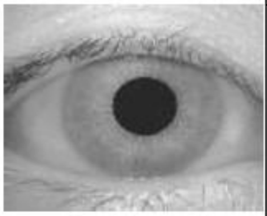
Iris sample 1	Iris sample 2	HD
		0.2195
		0.2798
		0.2594

Table 1 Hamming Distance for Iris samples of same person

TcirclesT When we take iris samples of two different person Hamming Distance will be greater than 0.3. Two different iris samples and its hamming distance is given as below:

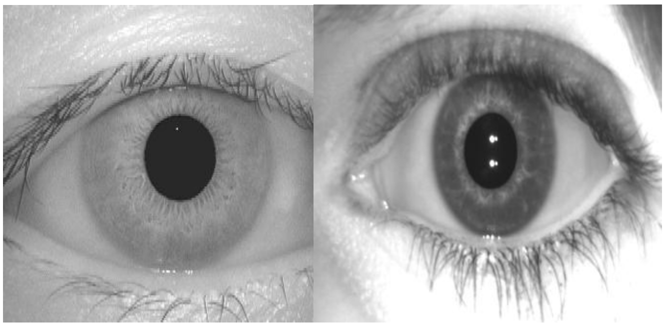


Fig 7: Iris samples of two different personsHamming Distance is 0.398

Commercially deployed iris-recognition algorithm, John Daugman's IrisCode, has an unprecedented false match rate (better than 10−11 if a Hamming distance threshold of 0.3 is used, meaning that up to 30% of the bits in two IrisCodes are allowed to disagree due to imaging noise, reflections, etc., while still declaring them to be a match.

V. CONCLUSION

After understanding importance of Iris detection and localization stage different detection techniques are implemented. For video frame pupil detection circular Hough transform, histogram equalization and thresholding are used. After measuring hamming distance iris of authorized person is identified.

VI. REFERENCES

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