HIGH PERFORMANCE IRIS RECOGNITION USING PHASE BASED IMAGE MATCHING

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ABSTRACT

With an increasing emphasis on security, the automated personal identification based on biometrics has received extensive attention. Biometrics employs physiological or behavioral characteristics to accurately identify each subject. Iris recognition draws an extensive attention of researchers now since iris is the annular part between pupil and white sclera with minute characters such as freckles, coronas and stripes. Phase based method is relatively simple and efficient compared to existing methods.

This project works on the phase based image matching methods. Iris recognition using the phase components in 2D Discrete Fourier Transforms of given images offers good results. The system operates in two steps, preprocessing stage and matching stage. Preprocessing includes mainly the extraction of feature. In the Matching stage, the Effective Region is extracted and finally the matching score is calculated by using the Band Limited Phase Only Correlation function. An efficient local appearance feature extraction method based the multi-resolution Curvelet transform is also used in order to further enhance the performance. Iris Recognition on Local Curvelet Block Based Classification along with the phase components encourages both accuracy and speed.

Keywords: *Biometric systems, Iris recognition, edge detection, Hough transform, Phase based method*

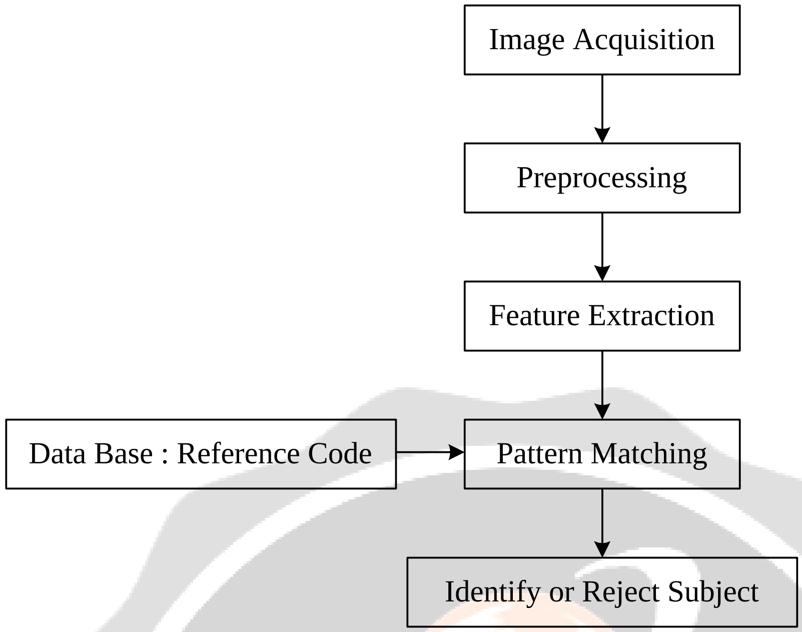
INTRODUCTION:

Biometric system provides automatic recognition of an individual based on some sort of unique feature or characteristic possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina, and the one presented in this thesis, the iris. Biometric systems work by first capturing a sample of the feature, such as recording a digital sound signal for voice recognition, or taking a digital colour image for face recognition. The sample is then transformed using some sort of mathematical function into a biometric template. The biometric template will provide a normalised, efficient and highly discriminating representation of the feature, which can then be objectively compared with other templates in order to determine identity. Most biometric systems allow two modes of operation. An enrolment mode for adding templates to a database, and an identification mode, where a template is created for an individual and then a match is searched for in the database of pre-enrolled templates.

The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitised image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wishes to be identified by iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified, or no match is found and the subject remains unidentified.

STAGES OF IRIS RECOGNITION

Biometric identification is the method of recognizing an individual based on physical and behavioral characteristics. The iris recognition system is the most promising method because the iris pattern is formed before three years of age and is unchanged through one’s life. Moreover, each person has a unique iris pattern. The uniqueness of the iris pattern was discovered by the ophthalmologists Leonard Flom and Aran Safir in 1987.



General steps of the iris recognition system

PREPROCESSING

In the first step of the iris recognition system, eye images are rapidly captured. These images always contain not only the useful parts but also some useless parts. Useless parts in the acquired images can cause reduction of the system performance. For this reason, the original image needs preprocessing. The preprocessing is composed of the following steps.

Iris localization

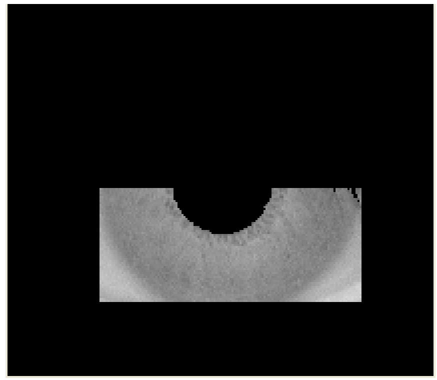
The localization technique used to determine the initial center coordinates of the iris from the minimum of the pixel values. This is implemented simply by the Hough Transform. The Hough Transform to find the circular regions. Before the Hough transform is applied, the edges are detected using the canny edge detector. Other Edge detectors could be used or a detector that is biased in the vertical direction could be used to properly detect the important edge features, corresponding to the sides of the iris and pupil, in the iris image.

Iris normalization

The size of pupil may change according to the variation of the illumination. This deformation of the iris can cause interference with the results of the pattern matching. To reduce this interference, the detected iris should be mapped to a rectangular block of texture of a fixed size. Due to the various types of registration transformation that can be present in the image and the elastic deformation that is caused by different illumination the iris has to be normalized before matching. One possible way to account for the deformation is to define a set of control points in a dilated image and a constricted image, and through using thin plate splines the deformation can be modeled more precisely than the polar coordinate system.

Feature Extraction

To provide accurate recognition of individuals, the most discriminating information present in an iris pattern must be extracted. Only the significant features of the iris must be extracted so that comparisons between templates can be made. The template that is generated in the feature encoding process will also need a corresponding matching metric, which gives a measure of similarity between two iris templates. The feature is extracted from the needed region, The irrelevant portions in the needed region like pupil is eliminated while extracting the feature as represented.



Feature Extraction

The effectiveness of the extracted feature is improved by segmenting the extracted region into multiple subregions. The feature is counter clock wised and the extracted regions is obtained.

Extracted region

This completes the preprocessing stage of iris recognition. The preprocessing stage can be quite common for all type of iris recognition methodologies. The effectiveness of the preprocessing is identified from the extracted region obtained from the feature of the input image.

MATCHING

Matching is done with the preprocessed output, In the Matching stage, the Effective Region is extracted and the Displacement alignment is performed and finally the matching is done. In order to enhance the performance and accuracy, the Matching is done by calculating the Euclidean Distance.

Effective Region Extraction

For a pair of normalized iris images to be compared, the purpose of this process is to extract effective regions of the same size from the two images. Let the size of two images be N_1 *N_2 and let the heights of irrelevant regions in h_f and h_g, respectively. We extract six subregions from a single iris image by changing the parameter ‘h’ correspondingly. The region of same size is extracted from the preprocessed image and the image in the database.

Matching Score Calculation

The BLPOC function between the aligned images $f(n_1, n_2)$ and $g(n_1, n_2)$ the matching score is evaluated. In the case of genuine matching, if the displacement between the two images is aligned, the correlation peak of the BLPOC function should appear at the origin. Thus, we calculate the matching score between the two images as the maximum peak value of the BLPOC function within the small window O centered at the origin. When multiple subregions are extracted at the “Effective region extraction” the matching score is calculated by taking an average of matching scores for six subregions.

Precise Matching with Scale Correction

For some iris images, errors take place in the iris localization process. This error causes slight scaling in the horizontal direction (that is, the n_1 direction) of the normalized iris image. In the case of the genuine matching, this reduces the height of the correlation peak. Thus, if the matching score is close to the threshold value to separate genuine scores and impostor scores, we generate a set of slightly scaled images, calculate the matching scores for the generated images, and select their maximum value as the final matching score.

Modified Algorithm for Degraded Iris Images

This section presents some modifications of the baseline matching algorithm which are especially suitable for degraded iris images. The baseline algorithm described in the previous section performs image matching only once by using the whole iris image, If the quality of iris images is sufficient, a single matching is enough to achieve a highly accurate iris recognition. When the quality of iris images is significantly degraded due to, for example, defocusing and blurring, it is difficult to achieve high performance by the baseline algorithm. Addressing this problem, we modify the matching algorithm by introducing a spatial ensemble averaging of the BLPOC function. Given a pair of iris images, we first divide each iris image into multiple small blocks (that is, subregions) and compute the BLPOC function for every block pair. Then, we take an average of the computed BLPOC functions across the whole image plane to improve the peak-to-noise ratio of the correlation surface. This technique leads to better discrimination capability, even for highly degraded iris images.

Block Partitioning

In the block partitioning, first partition the aligned iris images $f(n_1, n_2)$ and $G(n_1, n_2)$ into multiple blocks. Assume that the size of a block is $B_1 * B_2$ pixels. The 2D DFTs of $S_i (n_1, n_2)$ and $T_i(n_1,n_2)$, which are denoted by $S_i(k_1, k_2)$ and $T_i(k_1, k_2)$, respectively. Then, we calculate the cross-phase spectrum. Finally the BLPOC function is defined.

Block-Based Matching Score Calculation

In this step, we calculate the weighted average of the BLPOC functions[8] evaluated from all block pairs. The weight w_i associated with the BLPOC function is determined depending on the number of irrelevant pixels that belong to the eyelid region in the blocks.

Weighted Euclidean Distance Matching

The weighted Euclidean distance (WED) can be used to compare two templates, especially if the template is composed of integer values. The weighting Euclidean distance gives a measure of how similar a collection of values are between two templates.

Result Analysis

No of Images	BLPOC Match	Avg BLPOC Match	Euclid Dist Match
5	**2**	**4**	**5**
10	**4**	**8**	**10**
15	**10**	**13**	**14**
20	**12**	**15**	**18**
25	**13**	**18**	**23**

Table 4.1 Matching Rate

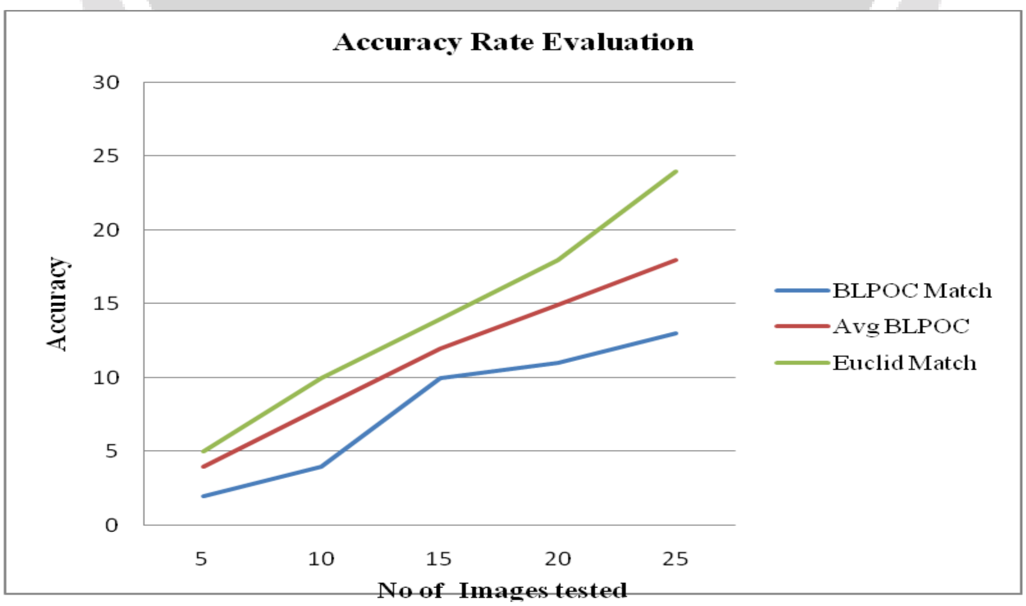


Fig 4.27 Performance Analysis, Accuracy rate

No of Images	BLPOC Match	Avg BLPOC Match	Euclid Dist Match
5	3	1	0
10	6	2	0
15	5	3	1
20	9	5	2
25	16	7	2

Table 4.2 Mismatch Rate

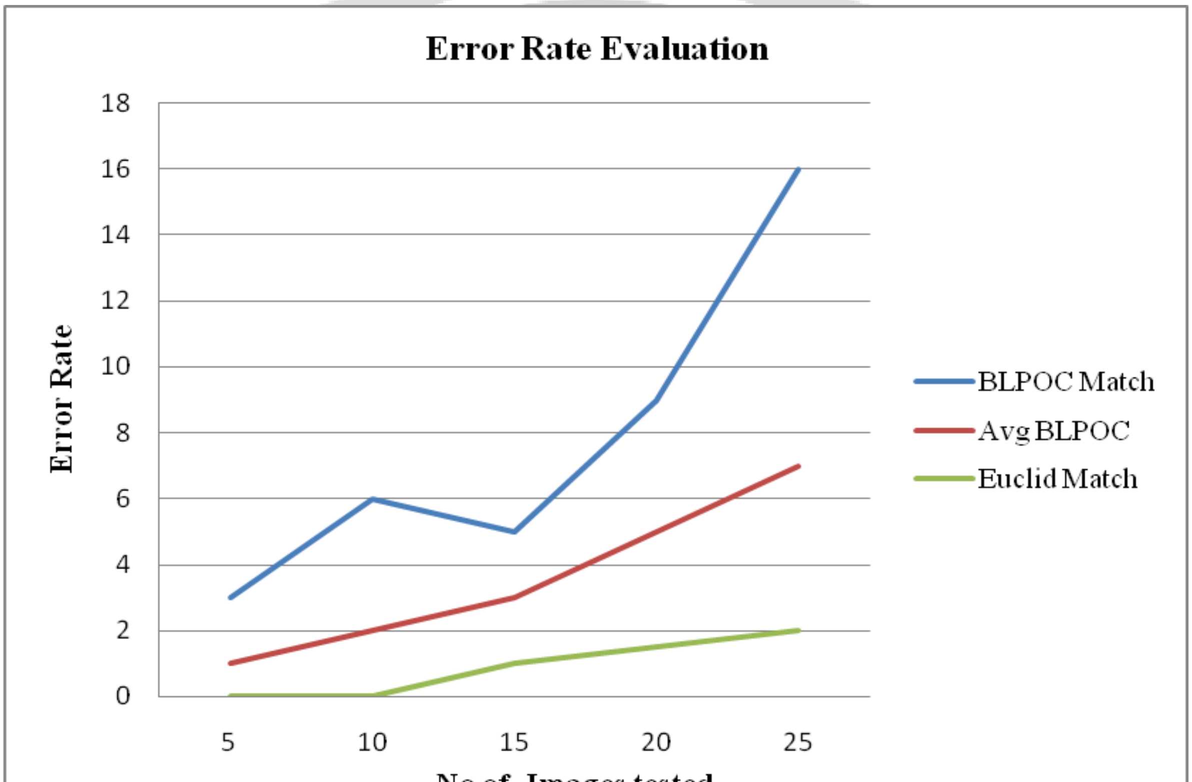


Fig 4.28 Performance Analysis, Error rate

CONCLUSION

Iris Recognition using phase based image matching is performed in two different ways, Multiple Subregion Method and Block Partition Method. Preprocessing and Matching are the important modules. In the preprocessing module, we first roughly determine the iris region in the original image, and then use edge detection and Hough transform to exactly compute the parameters for Localization. The Baseline Algorithm is used in to extract the feature and to perform the matching operation, the matching is done by Effective Region Extraction, Displacement alignment and finally the matching score is calculated. The algorithm is enhanced at the Matching stage for the Block Partition method. The correlation peak of the BLPOC function should appear at the origin. Thus, we calculate the matching score between the two images as the maximum peak value of the BLPOC function.

The Iris Recognition using block partition is highly efficient when tested with ‘n’ number of samples. An efficient local appearance feature extraction method based the multi-resolution Curvelet transform is also implemented in order to further enhance the performance. In this enhanced method, the Euclid Distance is used as the parameter for matching. This method of Iris Recognition method based on the multi-resolution Curvelet transform is highly efficient and accurate. The accuracy of the methods implemented were tested with '25' number of samples. The rate of accuracy is about 41 times improved than the existing methods. The error rate is minimized about 35.3 times than the existing systems.

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