IRIS Detection using Hamming Distance Model

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Abstract:
NEC and R&D offers biometric authentication technologies, NEC aims to realize a safe, secure, efficient, and equal society by expanding iris matching solutions for criminal investigation, immigration control, and national identification systems in different regions around the world. This paper attempts to describe a unique approach to create an iris feature extraction and matching system. Gabor wavelet transform is applied to extract the patterns in a person's iris in Hamming distance between two pairs of iris in data matrix. To conclude, our method has achieved a better total successive rate (TSR) and reduced equal error rate (EER), false accept rate (FAR) and false reject rate (FRR). Proposed algorithm accuracy rate is good Compare than the existing algorithms.

Keywords: Hamming Distance, Total Successive Rate, Gabor Wavelets

I.INTRODUCTION

Our iris recognition solution offers improved security and smooth personal identification amidst the increasing movement of people between countries. The iris is photographed, and the image is matched with the government's immigration control database during exit or entry procedures at the passport control booth, enabling rapid and stringent personal authentication. Our solution provides improved security through stringent recognition, as well as improved convenience through smooth authentication procedures. Highly accurate and fast, iris recognition boasts of having top-class precision among different types of biometric authentication technologies. Remains unchanged throughout life. (This does not constitute a guarantee.) Since the iris is different between the left and right eye, recognition can be performed separately by each eye. Possible to distinguish twins. As long as the eyes are exposed, iris recognition can be used even when the subject is wearing a hat, mask, eyeglasses or gloves. Because of using an infrared camera, recognition is available even at night or in the dark. Without the need to touch the device, contactless authentication is possible, making it hygienic to use. Biometric has been widely used in several applications in our day to day life.

II. System Model of Hamming Distance

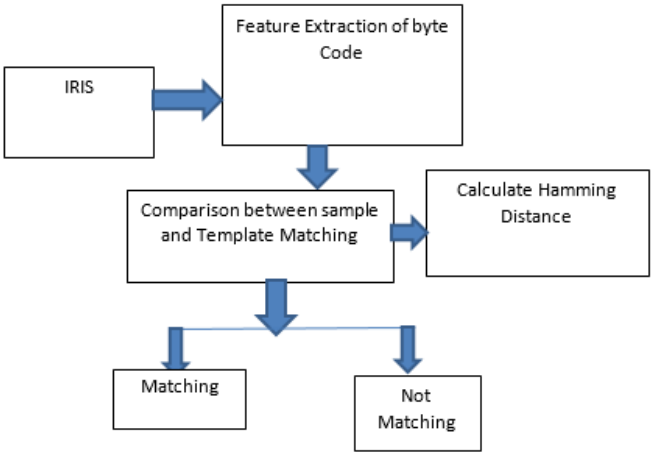

Figure 2. Hamming Algorithm

Eye Image Acquisition

The images were mainly taken for the purpose of iris recognition software research and implementation, where infrared light was used for illuminating the eye, and hence they do not involve any specular reflections. Cassia iris VI contains a total of 756 iris images from more than 108 subjects. All the images are 8-bit gray level bitmap files which are collected under near infrared illumination.

Iris Code Generation

In iris code generation algorithm, Gaussian filter is used to extract the iris features. To create iris code feature extracted image is divide into vertically 16 blocks. For the first step fixing the normalized image size as 64 X 512. Then divide normalized iris image size into basic cell regions for generation of iris code. If suppose only one cell region has 64 ×32 pixels size, then a Standard deviation of pixels value is used as a representative value of a basic cell region for calculation. Second step is conversion, the whole number values are converted into binary values like 0's and 1's. Here 16-bit number values are converted into 16-bit binary values by considering the threshold as mean from each block. If suppose the pixel values are greater than the threshold value mark it as one or else mark it as zero. Now the Iris code generation algorithm generate 16-bit binary values for the purpose of iris verification. Based on this 16-bit binary values the matching process will start. The template matching process is mainly classified into four steps. The first step Bringing the newly acquired iris template into spatial alignment with a candidate database entry. Choosing a representation of the aligned iris template that makes their distinctive pattern apparent. Evaluating the goodness of a match between the newly acquired and database representation. Deciding if the newly acquired data and the database entry were derived from the same iris based on the goodness of the match.

3.1 Gabor Wavelet Transform Algorithm

Feature extraction is done with the help of Gabor Wavelet Transform

Gabor Wavelet is defined by

$$J(\rho,\phi) = I_E(x_0 + r\cos\theta, y_0 + r\sin\theta) \quad (1)$$

Where

$$r = r_i + (\rho - 1)\Delta_r, \forall \rho \in N : \rho \le \frac{r_e - r_i}{\Delta_r} \quad (2)$$

$$v = \begin{Bmatrix} \frac{-\pi}{4} + (\phi - 1) \times \Delta_\theta if\, \phi \le \frac{\pi}{2\Delta_0} \\ \frac{3\pi}{4} + (\phi - 1) \times \Delta_\theta if\, \phi > \frac{\pi}{2\Delta_0} \end{Bmatrix} \quad (3)$$

Where I_E denotes the iris image gray level with the sclera and pupil extracted and r_e are the inner and outer radius. (x_0, y_0) is the pupil Centre and Δ_r and Δ_0 are the magnitude and the angle sample intervels.

Convolute Gabor filter with iris image : Imaginary part of Gabor filter J is weighted with orientations (0, $\frac{\pi}{4}$, $\frac{\pi}{2}$ and $\frac{3\pi}{4}$). This is computed by the division of image in squared section with following equation used.

$$C(i,j) = \sum_{x=1}^{N}\sum_{y=1}^{M} j(i + x - \frac{N}{2}, j - \frac{M}{2}) \times g(x, y, \varphi_k, \lambda) \quad (4)$$

Where

$$g(x, y, \varphi_k, \lambda) = \exp\left\{\exp-(\frac{x\cos\psi_k}{\sigma_y^{\,2}})^2 + (\frac{-x\sin\varphi}{\sigma_y^{\,2}})^2)\right\} \times \sin\left\{\frac{2\pi(x\cos\varphi_k + y\sin\varphi_k)}{\lambda}\right\} \quad (5)$$

The filter dimension is $N \times M, (i,j)$ is the centre of each section and $x, \lambda, \sigma_x, \sigma_y$ are filter parameters.

Hamming Distance:

Psedocode of Hamming Distance Calculation

Iteration1 : Compare Query iris feature vector with stored image feature vector of database.

Iteration 2: Hamming distance is calculated for each image feature vector.

Iteration 3: Finally Calculate minimum Hamming Distance Values.

$$HD = \frac{1}{N}\sum_{j=1}^{N} C_A(j) \oplus C_B(i) \tag{6}$$

Example for Hamming Distance Calculations

A	0	1	1	0	1	0	1	0
B	1	1	0	1	1	0	1	1
A XOR B =	1	0	1	1	0	0	0	1

They differ in four places, so the Hamming distance d(01101010, 11011011) = 4
The Hamming distance of this 8-bit string is 4, the number of ones (1's) in the XOR string

IV. Implementation Results

The Iris database contains a total of 756 iris images from more than 108 subjects. This research shows 4 output samples.

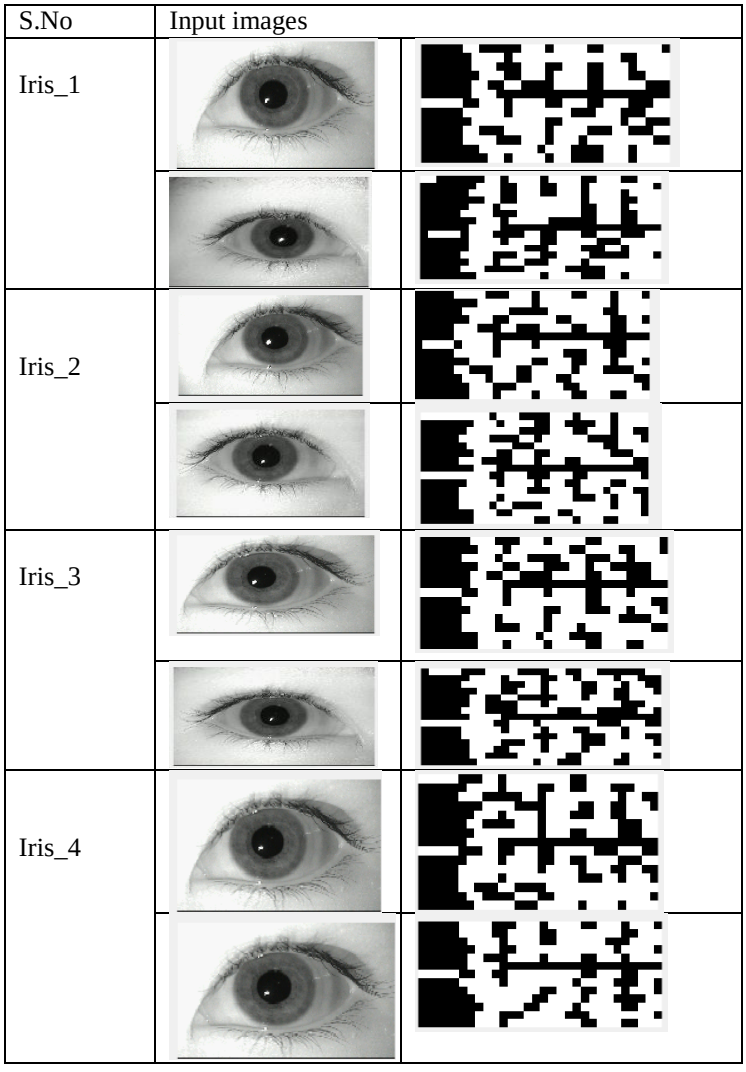

Figure 3. Output Images

Table Comparison table for existing and proposed algorithms

S.NO	Author	Technique	Accuracy rate
1.	Gundeep Singh Bindra et.al	2-D wavelet transform using sobel edge detection, matching, Euclidean distance	92.82%
2.	Asama Kuder Nsaef et.al	Daugman's Integro- Differential operator, matching using hamming distance	98.76%

3.	Afsana Ahamed and Mohammed Imamul Hassan Bhuiyan	Iris recognition is done using curvlet transform, matching is done employing the correlation coefficient	99.3%
4.	Proposed Algorithm	Proposed Algorithm (Gabor wavelet Transform and Hamming Distance)	100%

Widget Model of Hamming Distance

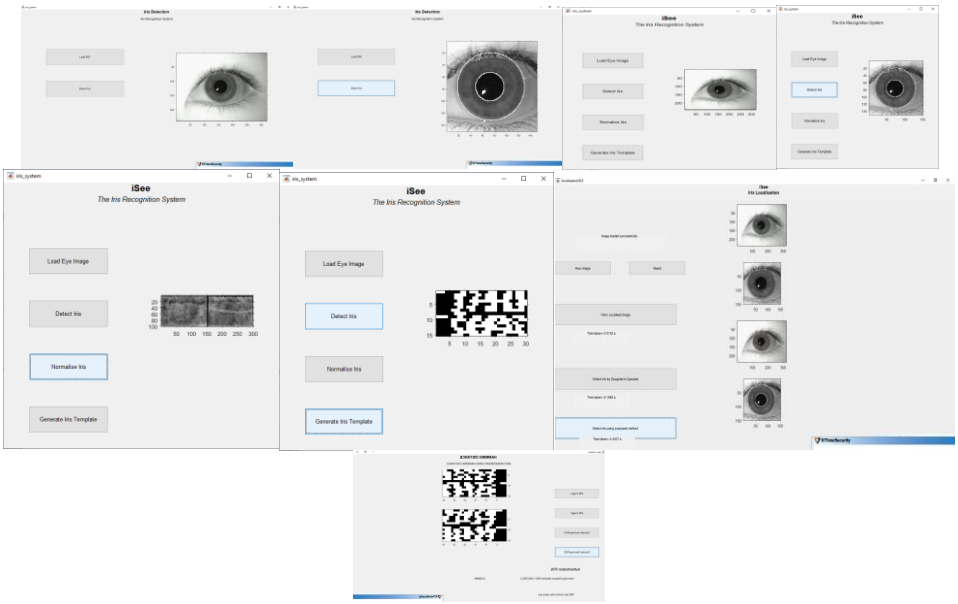

Figure .4 Iris Recognition using Hamming Distance Widget

V.CONCLUSION

The current study revealed that that the proposed technique was successful in obtaining higher TSR and better EER values. The FAR and FRR values are reduced. This has been achieved as the proposed method uses Gabor wavelet transform techniques, which gives a better transform result and the matching process is implemented using Pairwise distance which computes the Hamming distance between pairs of objects in data matrix. To conclude, the study was limited to certain aspects, and several useful aspects have been suggested in this study as to carry out future research in this area

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