Smart Sensors Ltd

Novel high performance iris feature extraction techniques

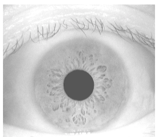
LOW COMPLEXITY HUMAN IRIS FEATURE CODING

Introduction

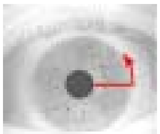
Smart Sensors Ltd offers a novel human iris coding algorithm, based on differences in the power spectrum of fragments from normalized iris images (Monro Iris Transform – MIT). For **identity recognition**, 100% correct recognition is achieved using a weighted Hamming Distance metric. For **identity verification**, a variable threshold is applied to the distance metric and the False Acceptance and False Rejection Rates are recorded. After tuning the various parameters, MIT achieves the lowest False Acceptance Rate at the point of first False Rejection amongst the three algorithms tested, as well as the lowest complexity.

Iris Image Normalization

First, the inner and outer iris boundaries are located to eliminate the pupil, eyelid and other "clutter". Then the iris image is transformed from polar co-ordinates to a 512x80 fixed size rectangular image to reduce the effect of iris dilation and contraction, of which 512x48 will be coded. The non-uniform background illumination is finally homogenized.

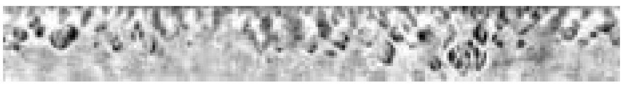


Original Image



Localized Image

Unwrapped Image



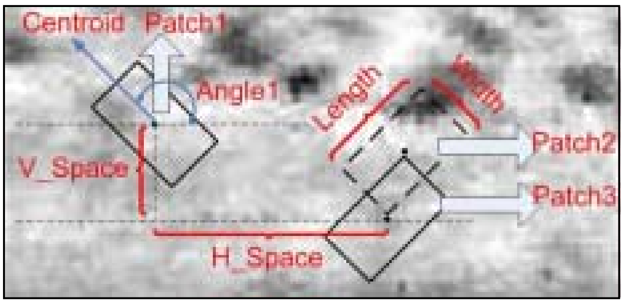
Enhanced Image

MIT Iris Coding Technique

Segmentation Into Patches

In order to apply the MIT iris coding technique, the iris image is divided into rectangular patches with particular size, orientation and relative position.

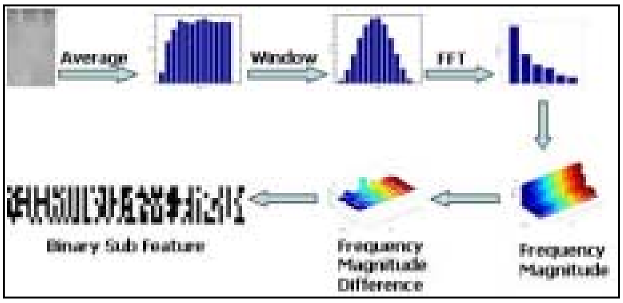
The 'patch' is the basic fragment used in our method. To obtain optimum performance we tune the length, width, orientation (angle) and the relative position of a series of patches.



Some of the parameters that enable performance tuning in MIT

Patch Coding

First a 1D intensity signal is obtained by averaging the patch across its width to reduce noise. The FFT is then applied to this 1D signal to obtain spectral coefficients. A window is employed before the FFT to reduce the spectral leakage. The Frequency Magnitude Differences between adjacent patches are calculated and a short binary code is generated from the zero crossings of each difference. These constitute the feature vectors of our iris code.



MIT Feature Vector generation process

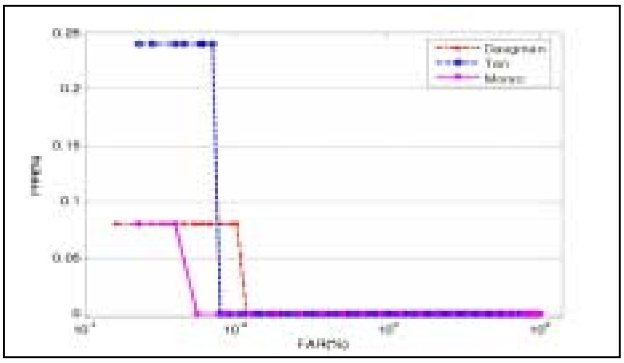
Classifier Design

A nearest neighbour classifier is used in matching. The distance between different iris feature vectors is measured by the weighted Hamming Distance.

$$Dis = \frac{1}{A}\sum_{i=1}^{N}\alpha_i[\frac{1}{B}\sum_{j=1}^{M}[\beta_j Feature1_{(i,j)} \oplus \beta_j Feature2_{(i,j)}]]$$

Experimental Results and Comparison

- **Database:** CASIA Database, 308 Classes, 2174 Images
- **CRR:** Correct Recognition Rate = 100%
- **Comparison in Verification Mode:** The Receiver Operating Characteristic shows the False Rejection Rate (FRR) as a function of the False Acceptance Rate (FAR)



Item / Methods	FRR at FAR= 0.00003	Feature Extraction (ms)	Matching (ms)	Feature Extraction +Matching (ms)
Daugman	0.08%	422	31	453
Tan (ITIP)	0.25%	125	68	193
MIT	0%	89	31	120

Speed and Performance Comparison at FAR=0.003%
(Matlab™ Implementation)

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