Novel Iris Recognition Technique using Fractional Energies of Transformed Iris Images using Haar and Kekre Transforms.

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Abstract— The theme of the work presented in the paper is novel Iris feature extraction technique using fractional energies of transformed iris image. To generate image transforms, Haar and Kekre transforms are used. The above transforms are applied on the iris images to obtain transformed iris images. From these transformed Iris images, feature vectors are generated by taking the advantage of energy compaction of transforms in higher coefficients. Due to this the size of feature vector reduces greatly. Feature vectors are extracted in 5 different ways from the transformed iris images. First way considers all the coefficients of the transformed iris image and the rest considers 99%, 98%, 97%, and 96% of the higher energy coefficients for generating the feature vector. Considering fractional energies lowers the computations and gives better performance. Also the size of feature vector is reduced greatly. Performance comparison among various proposed techniques of feature extraction is done using Genuine Acceptance Rate (GAR). Results have shown that by considering fractional energies gives better results as compared to considering 100% energies. Also, the retrieval speed and computations are reduced greatly. Finally, Haar transform gives better performance as compared to Kekre transform. The proposed technique is tested on Palacky University Dataset.

Index Terms—Biometrics, Feature Vector, Genuine Acceptance Rate, Haar Transform, Iris Recognition, Kekre Transform.

1 INTRODUCTION

Biometrics makes use of bio-logical characteristics of a person like a person's physical or behavioural characteristics. Iris Recognition is a biometric which uses the patterns within the iris to uniquely identify a person. Human iris is the most reliable biometric because it is stable, unique and non-invasive in nature. Iris Recognition has attracted the attention of various biometrics based applications. Also it is very challenging, fastly growing and interesting area in real life applications. Iris recognition identifies a person by gathering one or more detailed images of the person eye with a sophisticated, high-resolution digital camera, and then it compares the subject's iris patterns with the patterns stored in database.

Iris recognition has a wide range of security-related applications like access control, secure online transactions, time and attendance management system, government and law enforcement, passport-free automated border-crossings, national ID systems, secure access to bank accounts at cash machines, internet security, anti-terrorism, computer login, cell phones and other wireless-device based authentication [14]etc.

Iris recognition technology has many advantages. It has the highest accuracy in comparison with other biometrics. Also irises are stable so one enrolment can last a lifetime. Even for a single person his irises are same. Also, identical twins have different iris patterns and the left and right eye of the same person are also different. Moreover, from the age of two the iris pattern doesn't change for a person.

2 IMAGE TRANSFORMS

2.1 Haar Transform

Haar transform is an orthogonal transform. The elements of Haar transform are derived from Haar matrix whose elements are either +1, 0, -1 multiplied by integer powers of $\sqrt{2}$. Haar transform has the advantage that it is fast, memory efficient and computationally simple [4].

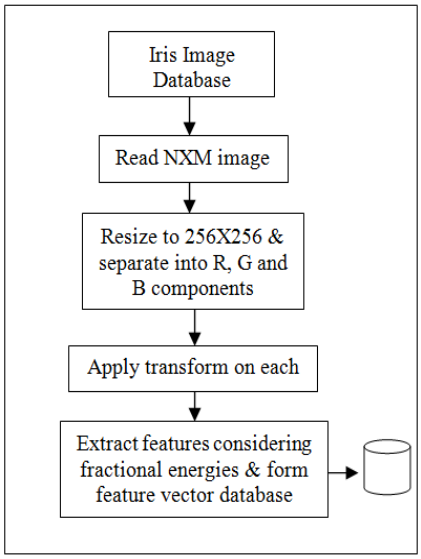
2.2 Kekre Transform

Kekre transform matrix can be of any size NXN. N need not be integer power of 2. All upper diagonal and diagonal elements of Kekre's transform matrix are 1, while the lower diagonal part except the elements just below diagonal is zero [1].

3 PROPOSED FEATURE EXTRACTION METHOD

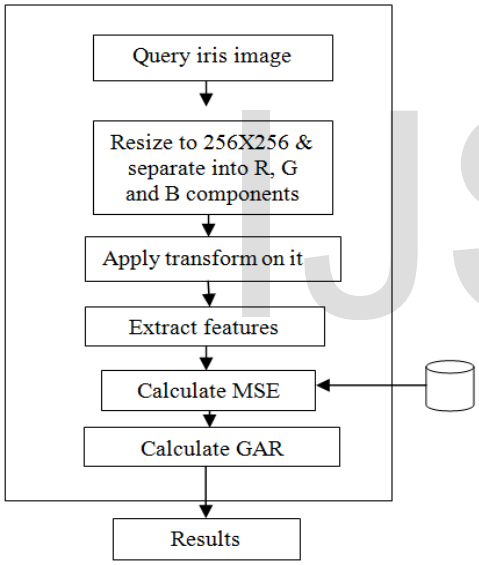
The proposed method includes two modules. One is feature extraction module and second is query execution module. Following figure represents the block diagram of proposed method.

Module 1:
Feature Extraction module



(a) Feature Extraction Module

Module 2:
Query Execution module



(b) Query Execution Module

Fig 1. Architecture of system

4 IMPLEMENTATION

4.1 Platform

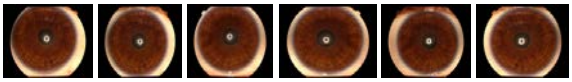
Experiments are performed on Matlab R2008a version 7.6.0.324, Intel core 3 processor (4GB RAM and 2.24 GHz).

4.2 Database

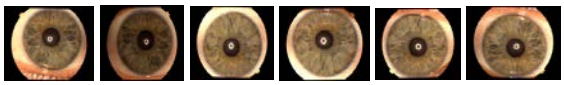
The proposed method is tested on Palacky University Dataset. This database contains total 384 eye images. Images are of total 64 persons including images of both males and females. Total six images are taken per person i.e. 3 for left eye and 3 for right eye. The size of image is 768X576 pixels. All the images were taken in a single session [15].

Following are the sample images from the Palacky database.

Person 1:



Person 3:



Person 5:

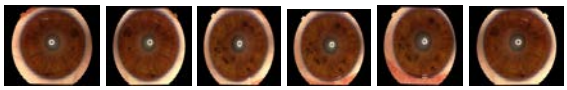


Fig 2. Sample images from Palacky Database

4.3 Similarity Measurement criteria

The feature vectors are matched using Mean squared error. It is a similarity measurement criterion for matching the feature vectors. Mean squared error between two feature vectors u and v is calculated as follows,

$$MSE = \frac{1}{N}\sum_{i=1}^{N}(u_i - v_i)^2 \quad (1)$$

Where, N is the size of the vectors to be compared. Low MSE indicates higher similarity between the feature vectors u and v.

4.4 Performance Comparison metric

Genuine Acceptance Rate (GAR) is used as a performance comparison metric to evaluate the performance of proposed iris recognition system.
GAR is defined by following equation,

$$GAR = \frac{number\ of\ correct\ acceptances}{number\ of\ identification\ attempts} \quad (2)$$

5 RESULTS AND DISCUSSIONS

To test the performance of the proposed method, total 384 queries were fired on the database containing 384 iris images. Matching between query feature vector and the feature vector in database is done using Mean Squared Error. Following figure 3 represents the GAR values using Haar and Kekre transforms.

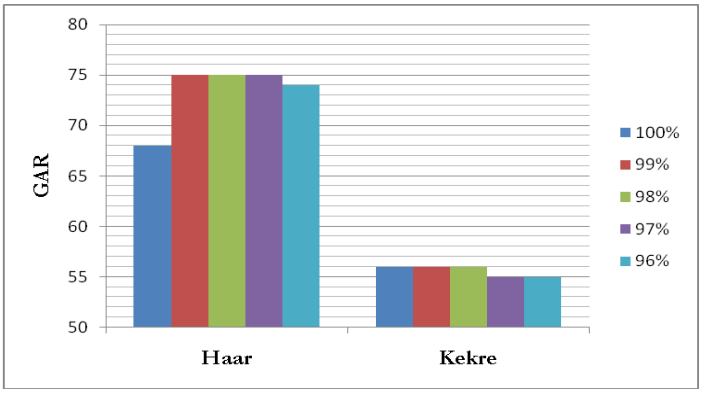


Fig 3. Performance comparison of transforms for respective percentage of fractional energies.

Transforms	Energy considered to form feature vector	No. Of Transform Domain coefficient considered	Reduction in size of feature vector	GAR	Percentage improvement in GAR
Haar	100%	256X256X3	0	68%	0%
	99%	20X3	196548	75%	7%
	98%	11X3	196575	75%	7%
	97%	8X3	196584	75%	7%
	96%	7X3	196587	74%	6%
Kekre	100%	256X256X3	0	56%	0%
	99%	3920X3	184848	56%	0%
	98%	2645X3	188673	56%	0%
	97%	2169X3	190101	55%	-1%
	96%	1887X3	190947	55%	-1%

Table1. Comparison of Methods

Table 1 shows the performance comparison between the proposed methods.

Results have shown that by considering fractional energies gives better results as compared to considering 100% energies. Also, the retrieval speed and computations are reduced greatly. Finally, Haar transform gives better performance as compared to Kekre transform.

6 CONCLUSION AND FUTURE SCOPE

Since the iris patterns are unique for every individual, iris recognition is a reliable biometric. In this paper an attempt is being made to achieve good performance and higher accuracy. Better feature extraction techniques are proposed using various transforms and by considering fractional energies of the transformed iris image. Future scope will be to achieve much higher accuracy, improve the performance and achieve fast computational speed.

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