Palm Print Identification Using Walsh And Hartley Wavelet Transformed Palm Edge Images With Fractional Coefficient

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***Abstract*—Paper present the concept of Fractional Coefficients of Transformed edge palm images with Walsh, Hartley Transform and their wavelet Transform. Palm print is one of the popular biometric in today's era because of its unique feature set (principal line, wrinkle and ridges).This feature set is considered here in form of the palm edge images which are obtained using various edge detection methods. In transform approach, energy of image get concentrated towards low frequency region, this idea is used to generate the transformed edge images by applying the transform to the edge images. The concept of Fractional Coefficients is used to minimize the feature vector size resulting in faster palm print identification. Experimentation is done on a test bed of 1000 palm print images (500 left and 500 right).Genuine acceptance rate is considered for performance comparison. The experimental results for Walsh Wavelet transform have shown performance improvement in palm print identification using fractional coefficients of transformed palm edge images. Wavelet transform shows better performance as compare to Image Transform in case of Walsh and Hartley transform. In all edge detection method Laplace and Canny edge detection method shows better performance. In all variation of proposed palm print identificationmethod, the fractional coefficients have shown better performance than 100% coefficient.**

Keywords—Biometrics, Palm print identification, Edge detection, Fractional coefficient,Walsh,Hartley Transform, Wavelet Transform,Genuine acceptance rate(GAR).

I. INTRODUCTION

Recently, Biometric identification gaining more attention from researchers. Biometric identification is an automatic recognition system which uses human's physiological or behavioral characteristics to identify the particular person. Number of biometric techniques is available. In all biometric technique palm print is gaining more attention because of several advantages as it require less cooperation from user for collecting the data, low cost scanning devices are sufficient to capture the image, it has sufficiently large Features which are useful to identify any particular user[5].

A palm print is basically the large inner surface of the hand. It has certain discernable and unique characteristics, which can be easily extracted using Palm print CapturingDevices [4] Palm print considered as a reliable human identifier because the pattern of human palm print not duplicated in other people, even in case of twins. More importantly, the details of these patterns are permanent. The rich structures of the palm print offer large amount of useful information for identification. [4]

Palm print as a Biometric System

Palm print identification uses the person's palm as a biometric trait for identifying or verifying who the person is. Basic Palm print Identification systems consist of five units [4]: palm print scanner, preprocessing, feature extraction, matcher, and database, as shown in Fig. 1.

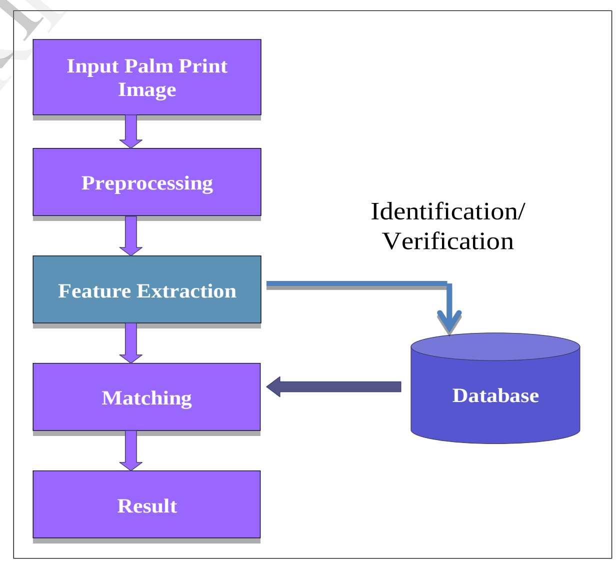

Fig.1. Basic Palm Print Identification System.

Palm print Scanner- The palms print scanner collects palm print images. There are four type of scanner used by the researchers. CCD based palm print scanner, digital camera, digital scanner and video camera for collecting the palm print image

Preprocessing- In preprocessing techniques different palm print images are aligned and central part of image is extracted for feature extraction.

Feature extraction and matching - After the preprocessing of palm print images features can be extracted for matching. A matcher compares two palm

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print feature setsand a database stores registered template [4].

In palm print identification system human palm characteristics are used for identification which are sufficiently large because of this it requires large number of calculation for matching, which increase the computational complexity and slow down the identification process. To speed up the identification system, it is important to consider only that region of palm which is giving the unique identification to each and every individual. In all Palm print identification process, Feature Extraction includes the extraction of that features which is unique for each and every individual. In feature extraction process only those features are considered which are sufficient to identify the particular person. There are two popular approaches for palm print Identification feature extraction. The first approach is based on the palm print statistical features while the other based on structural features. In statistical feature based palm print identification approach, it includes Eigen palm, fisher palms, and local texture energy. In case of Structural approach, extractions of structural information, like principal lines and creases, from the palm are considered [7].

This paper presents the proposed feature extraction process based on the concept of fractional coefficients of transformed edge image as a feature vector using Walsh and Hartley Transform and their respective wavelet transforms. Edge palm images are obtained by applying different edge detection techniques on palm images. The fractional coefficients are extracted from transformed edge palm image, which are considered as a feature vectors.Obtaining the palm edge image discussed in section *A*,section*B*discussed generation of wavelet transform and Concept of Fractional Coefficient discussed in section *C*.

A. Transformed Edge palm images

In this paper, Transformed edge palm images are obtained from transformed images by applying different edge detection techniques.Five different edge detection techniques are used belonging to gradient slope magnitude and Laplacian edge detection method. The five different edge detection techniques used are namely Sobel, Laplace, Prewitt, Canny and Robert [6]. Fig.2. Shows the Edge Extraction Process with Sobel gradient mask.Similarly different edge palm images are obtained using remaining edge detection methods as shown in Fig.3. And finally transformed are applied on edge matrix to generate Transformed edge images.

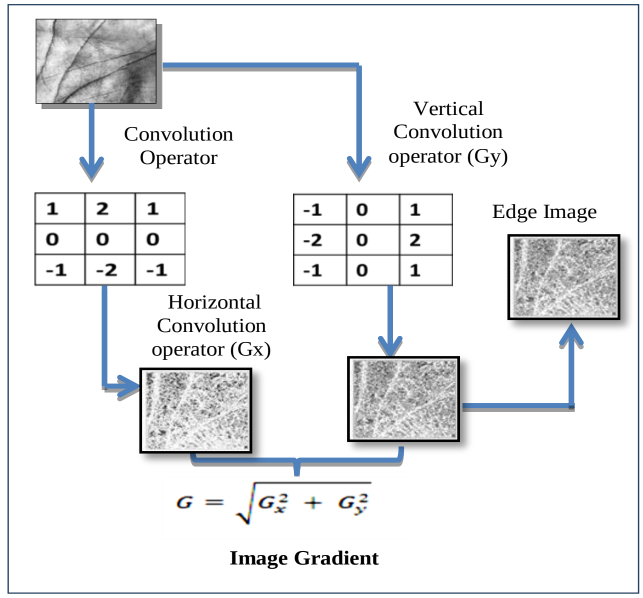

Fig.2. Edge Extraction Process using Sobel Edge detection Method

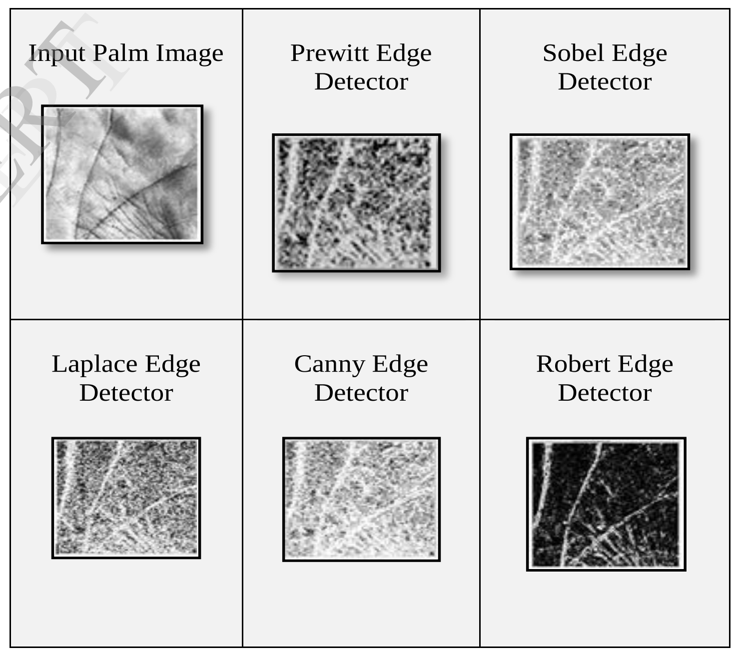

Fig.3. Obtained Sample Palm Edge Images from input palm image

B. Genaration of wavelet Transform

For generation of wavelets transform of size N^2xN^2 from any NxN orthogonal matrix is as given below.

Consider any orthogonal transform matrix T of size NxN as shown in Fig.4.

T_{11}	T_{12}	T_{13}	….	$T_{1(N-1)}$	T_{1N}
T_{21}	T_{22}	T_{23}	….	$T_{2(N-1)}$	T_{2N}
T_{31}	T_{32}	T_{33}	….	$T_{3(N-1)}$	T_{3N}
. .	. .	. .	. .	. .	. .
T_{N1}	T_{N2}	T_{N3}		$T_{N((N-1)}$	T_{NN}

Fig.4.Orthogonal transform matrix of size NxN.

To generate wavelet transform matrix from NxN orthogonal transform matrix perform the following steps [2],

1. For generating the first N number of rows of Wavelet transform matrix, repeat every column of transform T, N times

2. For generating next (N+1) to 2N rows, second row of transform T is translated. To generate next (2N+1) to 3N rows, third row of transform T is translated.

3. Finally, to generate last ((N-1) N + 1) to N2 rows, Nth row of transform T is used. By repeating every column of the basic transform N times we are generating Mother wave.

T_{11}	T_{11}	…	T_{11}	T_{12}	…	T_{12}	…	T_{1N}	..	T_{1N}
T_{21}	T_{21}	…	T_{21}	T_{22}	…	T_{22}	…	T_{2N}	..	T_{T2N}
T_{31}	T_{31}	…	T_{31}	T_{32}	…	T_{32}	…	T_{3N}	..	T_{3N}
. .	. .	…	. .	. .	…	. .	…	. .	..	. .
T_{N1}	T_{N1}	…	T_{N1}	T_{N2}	…	T_{N2}	…	T_{NN}	..	T_{NN}
T_{21}	T_{22}	…	T_{2N}	0	…	0	…	0	..	0
0	0	…	0	T_{21}	…	T_{2N}	…	0	..	0
	. .			. .				. .		
0	0	…	0	0	…	0	…	T_{21}	..	T_{2N}
T_{31}	T_{32}	…	T_{3N}	0	…	0	…	0	..	0
0	0	…	0	T_{31}	…	T_{3N}	…	0	..	0
	. .			. .				. .		
0	0	…	0	0	…	0	…	T_{31}	..	T_{3N}
		… …			… … .		… … .		.. ..	
T_{N1}	T_{N2}	…	T_{NN}	0	…	0	…	0	..	0
0	0	…	0	T_{N1}	…	T_{NN}	…	0	..	0
	. .			. .				. .		
0	0	…	0	…	0	0	…	T_{N1}	..	T_{NN}

Generated wavelet matrix of size P2xP2 form orthogonal transform matrix T of size NxN as shown in Fig.5.

In this paper, wavelet transforms are generated from its orthogonal transform usingabove wavelet generation technique.

Fig.5. Generation of Wavelet Transform.

C. *Fractional Coefficient*

In transform domain approach it is observed that, after applying transform to an image the entire energy of image get concentrated towards the particular corner of the image[5], so by considering that high energy region (which is known as Fractional Coefficient) identification process can be speed up. The percent of the fractional coefficients are extracted from transformed edge images based on energy compaction which are considered as a feature vector, Fig.6 Shows Feature vector extraction process considering fractional coefficient [1].As a result, the feature vector size is reduced resulting in the speed up of palm print identification and the experimentation results shows the performance improvement in fractional coefficients compared to 100% coefficient of transformed data.

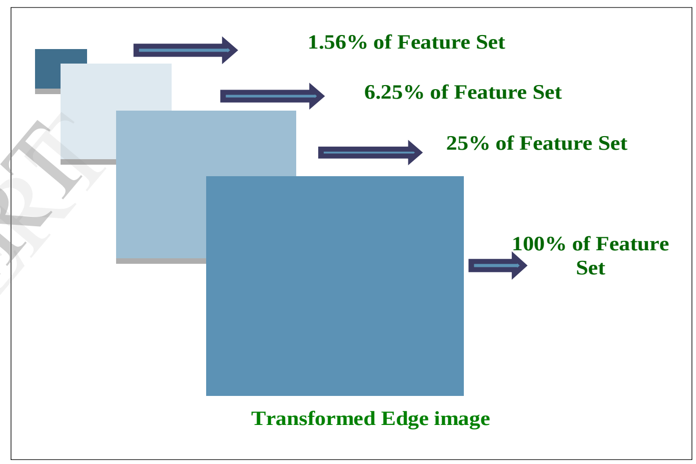

Fig.6. Feature vector extraction method considering fractional coefficient

II. PROPOSED PALM PRINT IDENTIFICATION

Here the palm print identification method is proposed by taking fractional coefficient of transformed palm edge images. The Hartley and Walsh Transforms and respective Wavelet transform are proposed to be used. For generation of palm edge images five assorted edge detection methods with Slope magnitude are proposed to be used as Prewitt, Sobel, Canny, Robert and Laplace edge detectors. The six various percentage of fractional coefficient are considered alias 25%, 6.25%, 1.56%, 0.39%, 0.10% and 0.024% along with 100% coefficients. In all 120 variations (with four transforms, five edge detection techniques and six percentages of fractional coefficients) of proposed palm print identification method are presented and experimented on a test bed[8] of 1000 palm print images. Fig.7. Proposed Feature Extraction Process for palm print Identification Process. [1]

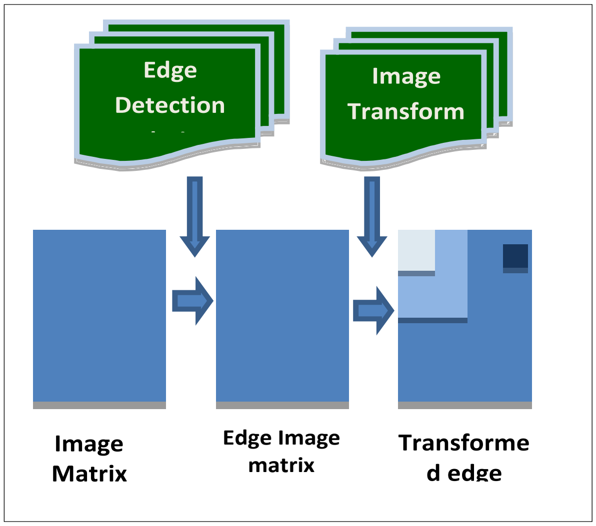

Fig.7. Proposed Palm print Feature Extraction technique

III. EXPERIMENTATION

A. Platform

The proposed palm print identification methods have been implemented with the help of MATLAB 2012 using a computer with Intel Core i3-3110M Processor with 2.40GHz and 4GB RAM.

B. Testbed

The proposed method is tested on segmented palm print image database of 1000 images of 100 people (500 left palm prints and 500 right palm prints) collected from IIT Delhi palm print database [8]. Per individual, database has ten palm print images, five samples of each left and right palm prints are considered. To check the performance of proposed palm print identification techniques, total 1000 queries are fired on each the left and the right palm print databases to computegenuine acceptance ratio (GAR) values per query. The similarity measure used for matching of query with database images is Mean Square Error (MSE) [3].

IV. RESULTS AND DISCUSSION

A. Walsh Transform

The GAR value for 100%, 25%, 6.25%, 1.56%, 0.39%, 0.097%, and 0.024% of fractional coefficients are calculated for proposed palm print identification system using Walsh transform [9] for five different edge detection method and is plotted in Fig.8.

For proposed palm print identification system GAR values for left palm print ,GAR values for right palm print and GAR values for both left and right palm print are considered. After considering both left and right palm print together System showing better improvement in GAR values. As the fractional coefficient reduced there is a considerable amount of degradation in GAR value for Laplace and Robert edge detection method.

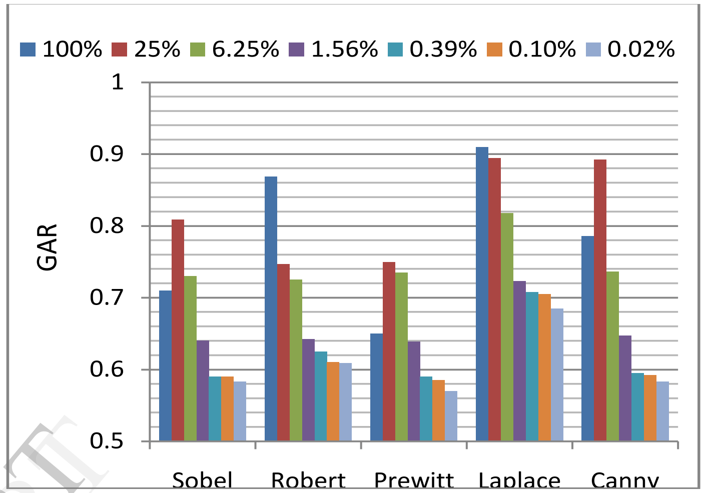

Fig.8.GAR values for proposed palm print identification system using Walsh transform for all edge detection method

In case of Sobel, Prewitt and Canny edge detection method shows the performance improvement with fractional coefficient. Laplace edge detection method shows better GAR value is 91% with 100% of fractional coefficient. After Laplace, canny has better GAR value is 89.2% with 25% of fractional coefficient. Robert has highest GAR value is 86.9% with 100% of fractional coefficient. Sobel has highest GAR value is 80.9% with 25% of fractional coefficient and at last prewitt has highest GAR value is 75% with 0.25% of fractional coefficient.

B. Hartley Transform

For proposed palm print identification system GAR value for 100% ,25%,6.25%,1.56%,0.39%,0.097% and 0.024% of Fractional Coefficient are calculated using Hartley Transform [5] for five edge detection techniques and plotted on Fig.9. For the proposed system both left and right palm print are considered.

Experimentation result shows the performance improvement with fractional coefficients. As the amount of considered fractional coefficient reduced, system shows better performance improvement for all edge detection techniques except Laplace edge detection method. Laplace edge detection method shows highest performance in terms of GAR value is 91% with 100% of fractional coefficient, followed by Laplace, Canny edge detection method shows better GAR value is 90.7% with 0.097% of fractional

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coefficient. Sobel and Prewitt shows better GAR value is 89.5% with 0.097% of Fractional coefficient and finally Robert has highest GAR value is 87.4% with 0.097% of Fractional coefficient.

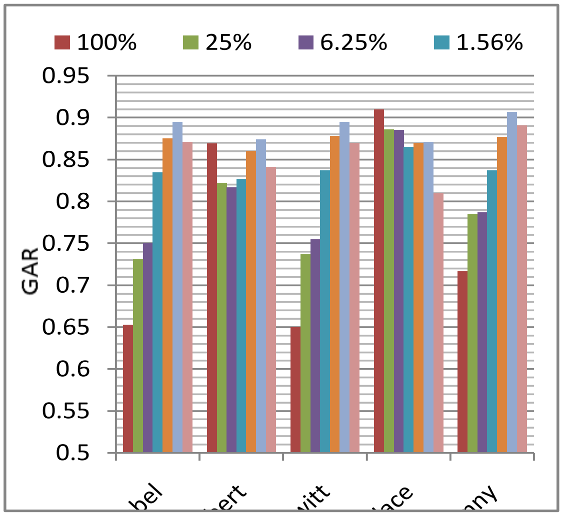

Fig.9.GAR values for proposed palm print identification system using Hartley transform for all edge detection method

C. *Walsh Wavelet Transform*

For proposed system GAR value is plotted using Walsh wavelet transform[9] for all edge detection methods with 100%,25%,6.25%,1.56%,0.39%0.097% and 0.024% of fractional coefficient. Fig.10. shows the GAR value plot for proposed system using Walsh Wavelet transform.Experimentation result shows the better performance in terms of GAR value for Walsh wavelet transform as compare to Walsh transform for all edge detection method.

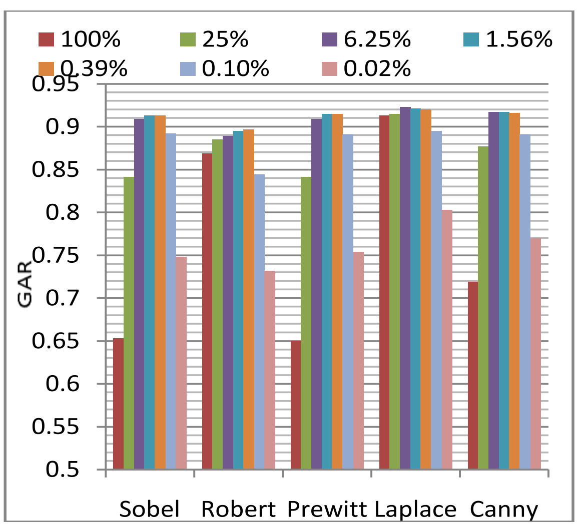

Fig.10.GAR values for proposed palm print identification system using Walsh Wavelet transform for all edge detection method

From the result analysis, Laplace edge detection shows the better performance with 92.3% of GAR value for 6.25% of fractional coefficient. Canny edge detection method shows better GAR value is 91.7% with 6.25% of fractional coefficient. Prewitt edge detection method shows better GAR value is 91.5% with 1.56% of fractional coefficient. Sobel has highest GAR value is 91.3% with 1.56% of fractional coefficient and highest GAR value for Robert edge detection method is 89.7% with 0.39% of fractional coefficient.

D. *Hartley Wavelet Transform*

Fig.11. shows the GAR value plot for proposed palm print identification system using Hartley Wavelet transform [9].From the result it is observed that, Hartley wavelet transform shows the better performance improvement as compare to Hartley transform in terms of GAR value. GAR value is calculated for all edge detection method with 100%, 25%, 6.25%, 1.56%, 0.39%, 0.097% and 0.024% of fractional coefficient.

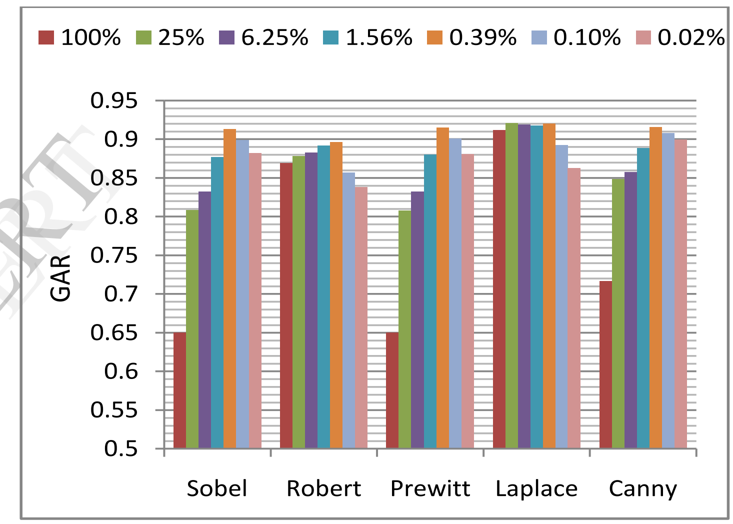

Fig.11.GAR values for proposed palm print identification system using Hartley Wavelet transform for all edge detection method

Result shows performance improvement in terms of GAR value for Laplace edge detection is 92.1% with 25% of fractional coefficient, for Canny edge detection method GAR value is 91.6% with 0.39% of fractional coefficient, for Prewitt edge detection method GAR value is 91.5% with 0.39% of fractional coefficient. Sobel with highest GAR value is 91.3% with 0.39% of fractional coefficient and Robert has highest GAR value is 89.7% with 0.39% of fractional coefficient.

V. COMPARATIVE ANALYSIS

Fig.12.shows the comparative analysis Walsh Transform Hartley transform and their respective wavelet transform 0.097% of fractional coefficient. After using the concept of fractional coefficient,

transform shows the performance improvement in terms of GAR value specially wavelet transform shows the better performance as compare to Image Transforms. From the result analysis, wavelet transform shows the better performance for canny edge detection method.

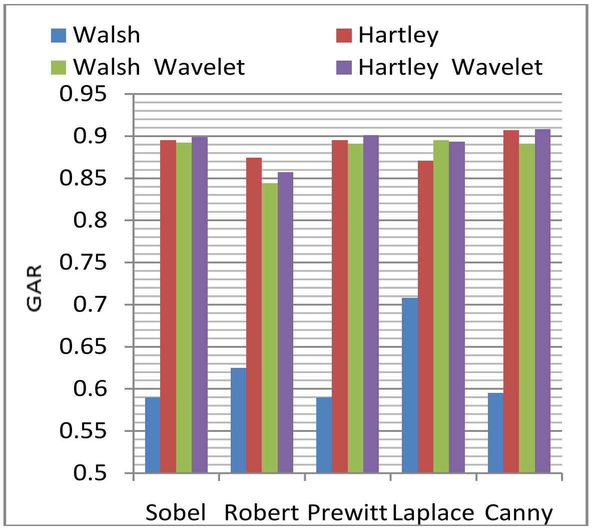

Fig.12. Comparative analysis Walsh, Hartley wavelet transform for Proposed palm print identification method

VI. Conclusion

In proposed palm print identification system, Transformed palm edge images are generated. Feature extraction is done using the concept of fractional coefficients. Fractional coefficient shows performance improvement in terms of GAR value for Image transform and their wavelet transform.

From the results, it is observed that Walsh Wavelet Transform shows better GAR value is.92.3% with 6.25% of Fractional coefficient. Wavelet transform proven to be better as compare to Image Transform and resulting faster and better palm print identification.. In all edge detection method Canny edge detection method and Laplace edge detection method proven to be better.

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