Palmprint and Handgeometry Recognition using FAST features and Region properties

Swapnali G. Garud[1]
Department of CS and IT,
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad, (M.S.), India.

K.V. Kale[2]
Department of CS and IT,
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad, (M.S.), India.

Abstract: Biometrics recognition system is more reliable and popular. In this paper we describe a palmprint and handgeometry based person identification consisting of three main steps - preprocessing techniques such as morphological operations. The feature extraction techniques such as FAST feature algorithm and region properties is used to independently extract palmprint and handgeometry features. Feature matching with euclidean distance classifier. These techniques are more reliable and faster than traditional techniques used. We finally conclude that the proposed methodology has better performance .This is supported by our experiments which are able to achieve recognition rate for palmprint 100 % and for handgeometry 93.75 %.

Keywords: Multimodal, FAST features, Region properties, Euclidean

1. INTRODUCTION

In real life effective access control system is challenging task. The biometric authentication system becomes very popular because it uses behavioral and physiological characteristics to uniquely identify the individual [1]. Biometrics authentication system useful in various applications such as physical access control, security, monitoring which is more secured than traditional password based security systems because it is not proper practice each time to remember long passwords hence password based authentication system is referred as the weak authentication mode and the Biometrics can be employed on various traits like fingerprint, palmprint, handgeometry, iris, face, voice, signature, etc which are unique for every individual hence are referred as strong authentication mode [2]. Biometrics system has two types i.e. verification systems and identification systems [3]. Many comparisons are required for this system Biometrics is of three modes i.e. unimodal biometrics which can identify individual by using single trait. Second is bimodal biometrics in which identification is done with fusion of two modalities and the other is multimodal biometrics which uses combination of multiple traits for identification purpose of human. A unimodal biometric may fails to be accurate enough for the identification of a user population and there is one more possibility of failure if physical characteristics of a person for the selected biometric is not available. The chance of any two people having the same characteristic will be optimized by highly unique features [4]. By combining information from different biometrics modalities we can achieve higher and more consistent performance levels [5]. A multimodal biometric system requires an integration scheme to fuse information obtained from the individual modalities. Biometrics system performance depends on quality of image [6]. There are different level of fusion available in biometrics. Amongst that feature extraction level is widely used because many observers prove that this level fusion produces better results. Usually, the performance of the biometric system is given by the accuracy of the system

In this paper new method is provided for personal authentication using palmprint and handgeometry that are simultaneously acquired from a single hand image. The database contains images of subjects for left and right hand . Each of these palmprint images are used to extract specific features. Thus the palmprint and hand geometry features of an individual are obtained from the same hand image.

The palm is the inner surface of a hand between the wrist and the fingers. The palm has unique features and provides a larger area so the more distinctive features can be generated to improve the performance of recognition system. There are different features that exists on a palm such as principle line, wrinkle line, delta point. The feature of palmprint is quite stable and specific because there is a little change in a long time. They can only be generated from a high resolution image, hard to be faked.

Hand Geometry gives the geometric structure of the hand. Hand geometry is suitable for integration with other biometrics. Hand Geometry is a biometric key with medium level of individualization. There are different features that can be extracted and used as key such as finger width and length, hand height, width, palm height, palm width, etc [7]. The feature of hand geometry is relatively simple and easy to use but it is not invariant due to a period of time.

The rest of the paper is organized as follows - Section II gives background of related work in literature. Section III gives proposed method which contains image acquisition, preprocessing, feature extraction techniques. Section IV discussed the experiments and results. Section V summarily devoted to conclusion. Section VI gives acknowledgement.

2. RELATED WORK

Slobodan Ribaric, et al [1] gives a bimodal biometric verification system for physical access control based on the features of the palmprint and the face, palm matching is based on the adapted HYPER method. And for face the K–L transform is used for matching. bimodal system can achieve an EER (equal error rate) of 3.08% for T=0.748 and the minimum TER (total error rate) = 5.94% for T = 0.8. Antonia Azzini, et al [2] given idea about using a fuzzy control system to manage a multi-modal authentication system, checking the identity of a user during the entire session. The first biometric acquisition takes matching score 0.725and the second biometric acquisition takes score 0.4860. Teddy Ko, [3] gives various scenarios in multimodal biometric systems using fingerprint, face and iris recognition, the levels of fusion that are possible and the integration strategies that can be adopted to fuse information and improve overall system accuracy. How the image quality of traits will affect the overall identification accuracy and the need of staffing for the secondary human validation . V. C. Subbarayudu, et al [4] proposed general working of multimodal biometrics system with Iris and Palmprint and fusion is done at the matching score level by Sum Rule technique with recognition rate is 96.6%. Andrew Teoh, et al [5] introduced k-Nearest Neighbourhood (k-NN) based classifiers are adopted in the decision fusion module for the face and speech experts with Recogntion rate is 80.33%. Anil K. Jain, et al [6] described an automated fingerprint recognition system and listed key challenges and research opportunities in the field. The recognition rate is 95%. Fan Yang, et al [7] fingerprint, palm-print and hand-geometry are combined for person identity verification. Wavelet transform to extract the features from fingerprint and palm-print is used and hand-geometry feature (such as width and length) is extracted after the pre-processing phase. Feature level fusion and match score fusion together for identity.The weight values are calculated based on total minimum error. i.e. For weight1- 0.75,weight2- 0.25.e X. Wu., et al [8] proposed a palm print recognition system by extracting features using Sobel operators and using Hidden Markov Models (HMM) as classifiers. Ajay Kumar, et al [9] attempts to improve the performance of palmprint-based verification system by integrating hand geometry features. These features are then examined for their individual and combined performances. The recognition rate is 98.3%.

Harpreet Singh, et al [10] have given iterative fuzzy approach for obtaining fused images Entropy values are provided in result as for Fuzzy algorithm entropy is 5.30 and for neuro fuzzy algorithm 4.89. Chun Wai Lau, et al [11] presents a multi-biometric verification system that combines speaker verification, fingerprint verification with face identification and equal error rates (EER) are 4.3%, 5.1% and the range of (5.1% to 11.5%) for matched conditions in facial image capture respectively. K. Ito, et al [12] suggested Multi-scale wavelet decomposition of palmprint images and using mean of each wavelet sub-block has been suggested .

M. Wang, et al [13] proposed 2D PCA and 2D LDA over conventional PCA have been reported to be better for palmprint recognition. V. Conti, et al [14] have proposed multimodal biometric system using two different fingerprints. The matching module integrates fuzzy logic methods for matching score fusion. Both decision level fusion and matching score level fusion were performed.

Kornelije Rabuzin, et al [15] had suggested active rules in fuzzy logic are used for effective decision making in person identification. The recognition rate is 97%.

Gawande, et al [16] used log Gabor filter can be used to extract the feature vectors from both Iris and Fingerprint and then they are concatenated. The phase data from 1 D log Gabor filters is extracted and quantized to four levels to encode the unique pattern of Iris and Fingerprint into bitwise biometric template. Hamming distance (HD) is used to generate a final match score. Yong Jian Chin, et al [17] proposed a multimodal biometrics system in which 2D gabor filter is used to extract features. The recognition rate is 98%. Cheng Lu, et al [18] suggested idea which utilizes two or more individual modalities, like face, ear, and fingerprint, to improve the recognition accuracy by new dimensionality reduction method called Dimension Reduce Projection (DRP). The recognition rate is 95.8%. Nicolas Tsapatsoulis, et al [19] presented an identification and authentication system based on hand geometry which used POLYBIO hand database. The recognition rate is 95%.

Anil K. Jain, et al [20] given an overview of biometrics, emerging biometric technologies and their limitations, and examines future challenges. Mohammad Imran, et al [21] proposed a new hybrid approach to verification aspect of a multibiometrics system, comparative analysis with traditional approaches such as multialgorithmic and multimodal versions of the same. The average EER of hybrid approach from different levels of fusion is 3.87% which shows that hybrid approach yields lower average EER. Mohamed K. Shahin, et al [22] introduced a multimodal biometric system (MMBS) based on fusion of whole dorsal hand geometry and fingerprints that acquires right and left (Rt/Lt) near-infra-red (NIR) dorsal hand geometry (HG) shape and (Rt/Lt) index and ring fingerprints (FP). Accuracy rate is 99.71%. S. Palanikumar, et al [23] presented approach for enhancing palmprint image. The enhancement is based on curvelet which preserves the fine features without noise. The result gives high PSNR (Peak Signal-to-Noise Ratio) value for the Curvelet method. i.e. 38.1047 .

Feifei CUI, et.al. [24] proposed multimodal biometrics recognition based on score level fusion of fingerprint and finger vein. Recogntion rate is 98.74%. Romaissaa Mazouni, et al [25] proposed a comparative study of several advanced artificial intelligence techniques (e.g. Particle Swarm Optimization, Genetic Algorithm, Adaptive Neuro Fuzzy Systems, etc.) as to fuse matching scores in a multimodal biometric system is provided. The fusion was performed under three data conditions: clean, varied and degraded. Some normalization techniques are also performed prior fusion so to enhance verification performance. The population based techniques (PSO, GA) gave very good results. Nishant Singh, et al [26] presents an efficient multimodal biometric system based on 4 slap fingerprint images. The system utilizes 4 slap fingerprint scanner to simultaneously collect fingerprints of multiple fingers on a hand in one image**.** Decision threshold is 0.9869 and FAR is 5.08%. Ashutosh Kumar, et al [27] suggested the new approach where the palmprint images are mapped to Eigen-space and a robust code signature is generated from different camera snapshots of the same palm to incorporate tonal and lighting variations. To enable real-time identification, the signature is represented by a low dimensional feature vector to reduce computational overheads. P.U. Lahane, et al [28] given the comparison of data base template and the input data is done with the help of hamming-distance matching algorithm. If the templates are matched we can allow the person to access the system. Gabor filter is used for fingerprint.

Krishneswari, et al [29] proposed to investigate the performance of multimodal biometrics using palm print and fingerprint. Features are extracted using Discrete Cosine Transform (DCT) and attributes selected using Information Gain (IG). Results shows an average improvement of 8.52%. D. Y. Liliana, et al [30] studied about biometrics of palm for identification system using block-based line detection for palm print feature extraction process, and chain code solved the hand geometric feature extraction. We combined those two respective features and recognized it using Dynamic Time Warping (DTW) method which was able to measure the distance between two different features. The accuracy rate is 89%. Gawande, et al [31] gives use of the log Gabor filter to extract the feature vectors from both Iris and Fingerprint and then they are concatenated. Finally the phase data from 1 D log Gabor filters is extracted and quantised to four levels to encode the unique pattern of Iris and Fingerprint into bitwise biometric template. Hamming distance (HD) is used to generate a final match score. Experimental results was verified on database of 50 users accounting to FAR = 0% and FRR = 4.3%. M. Dale, et al [32] presented palm texture using transform features and hand geometry features are represented as distances between different boundary points. The final decision is made by fusion at decision level. S. Rao, et al [33] suggests image fusion using fuzzy and neuro fuzzy logic approaches utilized to fuse images from different sensors, for enhancing visualization. Mohammad Abdolahi, et al [34] proposed two biometric traits such as iris and fingerprint which uses Decision level fusion and Fuzzy logic as technic for the effect of each biometric result combination. Recognition rate is 71%.

There are many challenges in traditional system such as they requires more time for recognition. This research tried to overcome this problem by suggesting new algorithm for finding the features of palm which is very much faster with higher recognition rate.

3. PROPOSED METHOD

The proposed method includes various steps such as image aquisition from sensor, preprocessing operation to enhance the quality of image and feature extraction process to identify the features of an image. Finally, matching is done on the basis of specific features with database image and decision is made for identification.

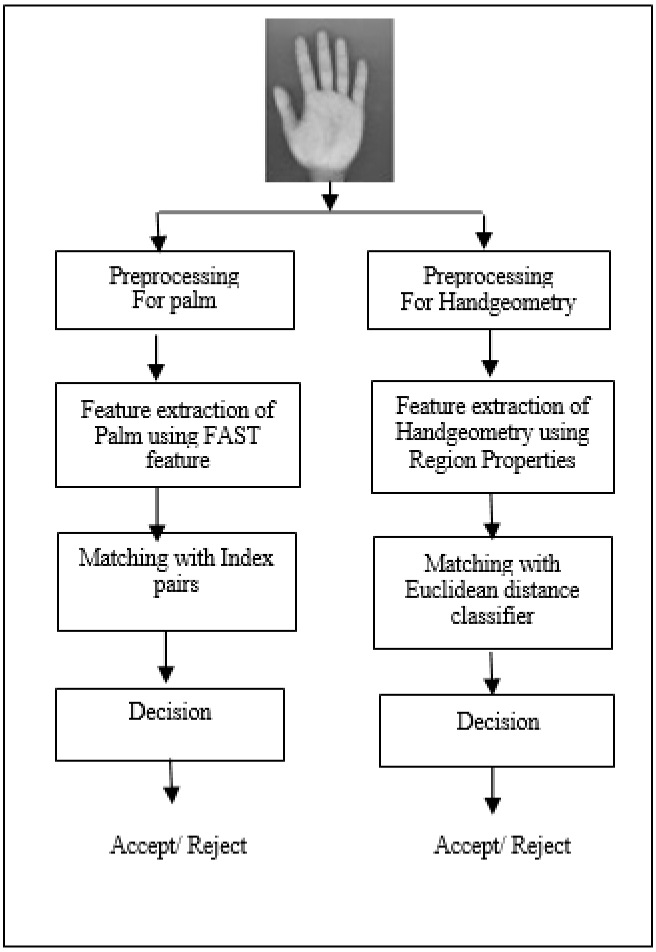

Figure 1. Block diagram of proposed system

The figure 1 shows the block diagram of proposed biometrics identification system.

3.1 Image Acquisition

We used KVKR Multimodal Biometrics database# This database contains images of different modalities such as palm , handgeometry, fingerprint, iris, face, voice, signature, HRV, knuckle, etc. of 150 subjects which belongs to age group of 20 to 30 years old . Out of which data for 7 subjects is used in this experiment. From this total 112 images for palmprint and 112 images for handgeometry of 7 subjects.

For extraction of palmprint images whole handgeometry images are employed. Palmprint images are acquised from the center of rectangle that can enclose the whole area of interest in palm. These center coordinates are used to extract a square palmprint region of fixed size. Out of these total 112 images of palmprint from database 8 images for left and right hand i.e. 16 images of every subject.

For extraction of handgeometry images we used Laserjet scanner and they are of JPEG format. The users were only requested with two preconditions first is their fingers do not touch each other and second is most of their hand touches the scanner surface. Handgeometry database is collected. We used total 112 images of handgeometry from database 8 images for left and right hand. i.e. 16 images for each subject.

3.2 Preprocessing techniques

For palmprint images we used center region of handgeometry images of specific size. These images are also colored images and we convert them firstly into grayscale images. Then specific threshold value is set for images for further processing.

For handgeometry images we used color hand images and they are firstly converted into grayscale format. Then we used morphological opening to estimate the background illumination. The opening operation has the effect of removing objects that cannot completely contain the structuring element. Then grayscale image converted into a binary image by using thresholding. After that background noise is removed. Then we found all the connected components in the binary image. The size of the objects has major concern in the accuracy of results.

3.3 Feature extraction techniques

For palmprint we extracted features such as corners points in grayscale images with the Features from Accelerated Segment Test (FAST) algorithm to find feature points. From these corner points interest point descriptors are extracted. These corner points are common for both images in the form of *Index Pair.* This algorithm also gives value of total number of Index pairs in images. Greater the value of index pair indicates that the images belongs to same subject and smaller value of index pair shows that the images belongs to different subject. The descriptors are extracted feature vectors and their corresponding locations, from a binary or intensity image. The function derives the descriptors from pixels surrounding an interest point. These pixels describe and match features specified by a single-point location. Each single- point specifies the center location of a neighborhood. The method used for descriptor extraction depends on the class of the input points such as SURFpoints, MSERobjects, corner points. FASTfeatures technique uses parameters as image, name and its scalar threshold value in the range (0,1). Name is MinContrast . It gives minimum intensity difference between corner and surrounding region, specified as the

is explained in Section 8. Annexure.

comma-separated pair consisting of MinContrast. The minimum intensity represents a fraction of the maximum value of the image class. Increasing the value reduces the number of detected corners. The default value is 0.2. A standard threshold value used in this experiment is 0.031 because at this particular threshold value we get maximum number of matching index pairs in images.

Table 1. Feature matrix palmprint palmprint images for Left hand

Sub	Index Pair1	Index Pair2	Index Pair3	Index Pair4	Index Pair5	Index Pair6	Index Pair7
Sub1	31.6	33	31	29.4	24.14	29.6	27.4
Sub2	16.9	31	33.8	26.3	41.12	41.4	31.6
Sub3	18.6	17.37	65	69.6	7	18.8	17.8
Sub4	15.5	15.12	5.12	5.5	11.25	10.8	56.5
Sub6	2.62	4.87	3.25	3.25	3.62	3.25	4
Sub7	1.5	1.25	1.63	1.75	1.12	2	2.37

Table 2. Feature matrix palmprint palmprint images for Right hand

Sub	Index Pair1	Index Pair2	Index Pair3	Index Pair4	Index Pair5	Index Pair6	Index Pair7
Sub1	23.38	25.50	90.50	11.50	33.13	28.00	7.88
Sub2	16.88	31.00	33.75	26.25	41.13	41.38	31.63
Sub3	5.13	5.00	8.25	7.50	8.38	9.88	9.63
Sub4	23.63	21.25	14.25	15.75	12.75	15.25	24.25
Sub5	9.88	15.00	19.63	14.75	20.25	16.25	15.00
Sub6	10.88	12.75	14.63	12.63	15.75	13.88	14.50
Sub7	3.25	3.25	2.63	3.25	4.38	1.38	0.63

For handgeometry we extracted features by using the region properties which measures properties of image regions. In this experiment we extracted features such as area, boundingbox, height of hand, perimeter, majoraxislength, minoraxislength by using the region properties of connected component of binary image of hand. The connected component gives the number of pixels. The area feature gives the actual number of pixels in the region. The perimeter gives distance around the boundary of the region. The Boundingbox gives smallest rectangle containing the region. It also gives the height of region. The majoraxislength specifies the length of the major axis of the ellipse that has the same normalized second central moments as the region and minoraxislength gives the length of the minor axis of the ellipse that has the same normalized second central moments as the region. By all these region properties we can easily discriminate the features of different images. First 6 samples were considered as training samples and mean is taken for those samples for all images for each subject. And remaining 2 samples of all features of each subject is considered as testing sample. In table 3 and 4 F1– F6 shows feature 1 to feature 6.

Table 3. Feature matrix handgeometry images for Left hand

Sub	**Area**	**Perimeter**	**Bounding Box**	**height**	**Major Axis length**	**Minor Axis length**
	F1	***F2***	***F3***	***F4***	***F5***	***F6***
Sub1	737798.83	11950.85	1413.83	1405.67	1341.01	934.16
Sub2	450250.50	7575.32	1137.17	1126.33	1057.40	770.87
Sub3	395181.33	6495.84	1031.83	1031.83	982.47	690.55
Sub4	459746.50	7010.65	1109.33	1109.33	1084.23	758.53
Sub5	409272.83	7206.35	1117.83	1055.33	980.00	774.93
Sub6	447932.83	6273.44	1114.33	1114.33	1062.16	703.51
Sub7	432571.67	8010.98	1020.00	1020.00	1022.54	766.52

Table 4. Feature matrix handgeometry images for Right hand

Sub	Area	Perimeter	Bounding Box	height	Major Axis length	Minor Axis length
	F1	***F2***	***F3***	***F4***	***F5***	***F6***
Sub1	746972.50	12162.86	1420.25	1412.67	1338.32	981.31
Sub2	460402.17	7306.92	1116.75	1114.83	1074.19	782.85
Sub3	402758.67	6349.36	1008.00	1008.00	982.88	728.61
Sub4	445831.17	6822.90	1156.67	1086.67	1038.19	811.78
Sub5	403517.67	6064.52	1015.50	1015.50	952.13	752.21
Sub6	444826.33	6331.65	1109.33	1109.33	1063.97	709.75
Sub7	457211.83	7846.00	1068.67	1068.00	1064.75	788.66

4. EXPERIMENT AND RESULT ANALYSIS

4.1 Palmprint Recognition

In palmprint we used 112 images for 7 subject of both left and right hand. From 112 we used 98 for training and remaining 14 for testing matrix. We test at least two images at a time for palm. By comparing results of these two images we can easily recognize the particular subject. If the image sample belongs to same person then the both image contains maximum no of matching corner points in common called as index pair. If the images doesn't belongs to same person then they have no matching points in common or negligible matching points in common. We can compare the test image against no of images at the same time with this process. The resultant matrix contains total no of index pairs for each pair of tested image samples. This test gives appropriate idea about the test sample belongs to which subject. Afterwards this matrix for further analysis and ease of use is reduced to the classification matrix which contains the total no of samples correctly classified in particular class for each subject. And 'x' entry indicates that no match in corresponding class. The table 14 shows classification matrix for palmprint samples.

Table 5. Classification matrix for palmprint samples

Test Sample	Sub1	Sub2	Sub3	Sub4	Sub5	Sub6	Sub7
	Class-1	*Class-2*	*Class-3*	*Class-4*	*Class-5*	*Class-6*	*Class-7*
Sub1-8	8	x	x	x	x	x	x
Sub2-8	x	8	x	x	x	x	x
Sub3-8	x	x	8	x	x	x	x
Sub4-8	x	x	x	8	x	x	x
Sub5-8	x	x	x	x	8	x	x
Sub6-8	x	x	x	x	x	8	x
Sub7-8	x	x	x	x	x	x	8

Table 6. Recognition rate for palmprint samples

Sub	Total no of sample tested	Correct classified	Miss Classified	RR
Sub1	8	8	0	100%
Sub2	8	8	0	
Sub3	8	8	0	
Sub4	8	8	0	
Sub5	8	8	0	
Sub6	8	8	0	
Sub7	8	8	0	

From table 6 it is observed that all samples of palmprint are classified into corresponding classes correctly. So the recognition rate achieved for palmprint images is 100 %.

4.2 Handgeometry Recognition

In Handgeometry we used 112 images for 7 subjects of both left and right hand. From 112 we used mean of 6 samples of each subject for every feature and remaining 14 images for testing matrix. First we calculate the feature matrix then the pairwise Euclidean distance between training matrix and testing matrix is calculated . Mean of each sample is tested with 7 and 8^{th} sample of each image. The resulting distance matrix for left hand as shown in table 7.

Table 7. Distance matrix for handgeometry images of Left hand

Sub	Sub1	Sub2	Sub3	Sub4	Sub5	Sub6	Sub7
S1 7	3237.69	284436.30	339515.14	274949.03	325415.50	286773.03	302109.23
S1 8	17642.45	269940.60	325020.00	260454.83	310919.47	272280.03	287612.29
S2 7	288754.75	1172.74	53907.36	10682.52	39806.82	1721.05	16513.26
S2 8	289191.26	1609.56	53471.03	11120.40	39370.11	1491.84	16075.74
S3 7	339392.12	51818.33	3499.28	61318.70	10856.12	49523.31	34139.46
S3 8	337535.79	49961.16	5259.06	59461.28	8999.66	47665.82	32282.82
S4 7	292207.52	4688.19	50465.13	14187.68	36358.05	3059.86	13046.86
S4 8	276100.54	11538.08	66569.02	2038.75	52480.42	13822.00	29211.19
S5 7	335803.32	48226.07	6876.59	57706.79	7308.97	45886.49	30583.64
S5 8	335730.56	48152.09	6942.57	57634.28	7224.00	45815.24	30506.56
S6 7	289863.07	2610.67	52811.37	11778.10	38730.75	59.76	15519.36
S6 8	291362.45	3974.38	51311.28	13274.46	37230.76	1440.89	14027.66
S7 7	301822.19	14271.89	40858.93	23784.26	26749.88	12110.10	3442.39
S7 8	300478.63	12928.42	42200.41	22440.85	28091.65	10782.82	4780.39

The resulting distance matrix for Right hand as shown in table 8.

Table 8. Distance matrix for handgeometry images of Right hand

	Sub1	Sub2	Sub3	Sub4	Sub5	Sub6	sub7
s1 7	2827.65	289439.45	347091.15	304016.61	346337.18	305030.39	292620.94
s1 8	6749.81	293344.99	350996.60	307922.52	350243.05	308937.07	296525.46
s2 7	281275.92	5336.18	62987.84	19914.99	62234.53	20939.23	8536.34
s2 8	280999.01	5613.05	63264.75	20191.78	62511.40	21215.72	8813.11
s3 7	351933.35	65321.54	7670.70	50745.85	8434.56	49738.64	62142.12
s3 8	353353.04	66741.43	9091.93	52166.19	9857.04	51159.67	63561.14
s4 7	299450.68	12840.31	44813.59	1791.90	44061.72	2899.73	9666.54
s4 8	299450.68	12840.31	44813.59	1791.90	44061.72	2899.73	9666.54
s5 7	349192.71	62581.19	4936.45	48003.67	5683.09	46992.86	59405.81
s5 8	346047.70	59436.10	1800.04	44858.69	2538.74	43848.39	56260.68
s6 7	302660.69	16069.11	41612.90	1589.54	40853.96	472.40	12945.52
s6 8	303024.01	16432.60	41249.96	1934.73	40490.88	831.17	13308.07
s7 7	288547.06	2152.80	55725.87	12699.12	54977.75	13757.05	1295.92
s7 8	283429.18	3458.70	60852.15	17833.70	60105.59	18888.69	6411.07

In table 7 and table 8 highlighted cells indicate the correctly classified values and highlighted values indicates the misclassified values.

Total 32 samples are tested for handgeometry. Out of which 30 are correctly classified and 2 are misclassified. The reason for miss-classification is the poor quality of images.

Table 9. Recognition rate for Handgeometry

Test	Total no of sample tested	Correct classified	Miss classified	RR
Left hand	16	15	1	93.75 %
Right Hand	16	15	1	93.75 %
Total	32	30	2	93.75 %

Table 10. Overall Recognition rate for palmprint and handgeometry

Test	Total no of sample tested	Correct classified	Miss classified	RR
Palm	56	56	0	100 %
Hand	32	30	2	93.75%

Figure 2 shows the Receiver Operating Characteristic curve for palmprint images and Figure 3 ROC curve for handgeometry images. The ROC is based on observed frequency and cumulative frequency. Performance True positive rate and false positive rates are analyzed with the ROC.

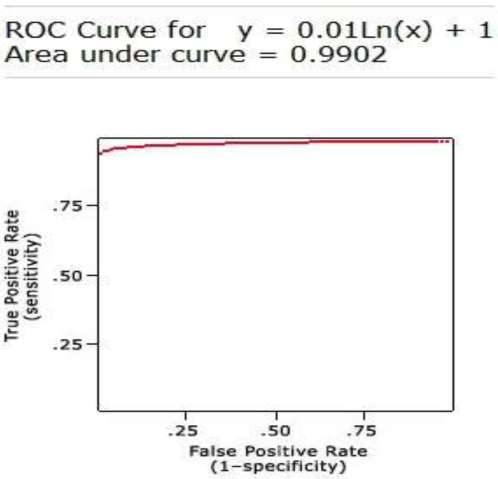

Figure 2. ROC curve for palmprint

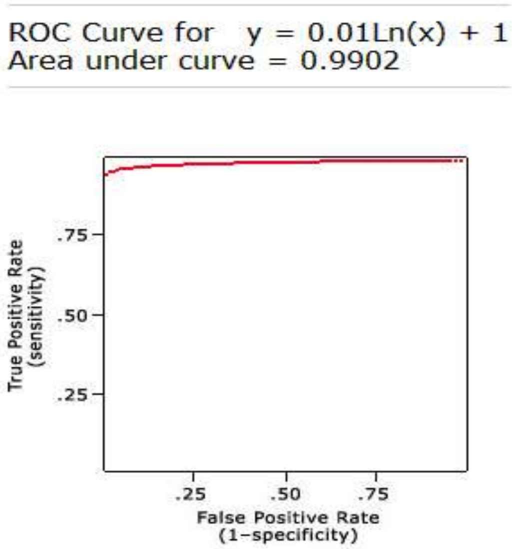

Figure 3. ROC curve for handgeometry

5. CONCLUSION

This paper presents palm and handgeometry recognition based on FAST features and region properties. The results clearly indicates the significance of the method used in this research work. For palmprint recognition the FAST features were utilized for classification for palm into appropriate classes. The observed classification success is 100%. The results of handgeometry recognition was improved and achieved 93.75 % recognition. These two methods can be collectively used for development of multimodal biometric recognition system in very effective way.

This work is more reliable because it gives faster results as compare to traditional biometric techniques. For palmprint recognition the new approach FAST feature algorithm reduces number of comparisons and provides easy recognition rate because it gives direct discrimination between image samples.

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8. ANNEXURE

The KVKR Multimodal Biometrics database is designed by research team from Biometrics Research Lab situated in Dept. of Computer Science and IT, Dr. B.A. M. Univeristy, Aurangabad, (M.S.) , India . under the guidance of Prof. Dr. K.V. Kale, Head, Dept of Computer Science and IT, Dr. B. A. M. University, Aurangabad. The author is one member of these research team.