

A New Palm Print Recognition Approach by Using PCA & Gabor Filter

Deepali Koul

M.Tech Scholar, Department of Computer Science &
Engineering
Kautilya Institute of Technology & Engineering, Jaipur
E-Mail: deep.koul22@gmail.com

Satish Kumar Alaria

Asst. Professor, Department of Computer Science &
Engineering
Kautilya Institute of Technology & Engineering, Jaipur
E-Mail: satish.alaria@gmail.com

ABSTRACT:-The key problems that involve in identification of palm print are searching for the better match from the test sample taken from input and also the available templates in the palm print database. The selection of the features and measuring similarity are 2 basic to be resolved. A feature that has higher discriminating ability should need to show a large variation between samples taken from totally different persons and small variation between samples taken from the palm of same person. Principal lines with information points are consider as very helpful palm print features and are successfully used for the aim of verification. Excluding these features there are many various features present in a palm print like: wrinkle features, geometry features, minutiae features and delta point features. It's noted that each one of those features of palm are involved with the native attributes supported points or line segments. 2 key points in palm print identification are: first is to develop an efficient algorithm that extracts helpful features and second is to correctly measure the similarity of 2 features sets. In contrast to the existing technique, propose a combine selection technique for identification by using the palm print feature base pattern matching by combining native and global palm print features in some stratified fashion. In this work, use PCA, Gabor Filter and KNN for the aim of classification and matching. This work show palm print authentication system operates in 2 ways in which first is enrolment and the second is verification. In enrolment, a user needs to offer palm print samples many times to the system. The samples is captured with the use of any image capturing device that then pre-processed and so extraction of features is done to provide the templates that keep template database. For verification user is instruct to produce his/her user ID and palm print sample, then the palm print sample are pre-processed and extraction of feature is done to compared it with templates keep within the database that belonging to constant user ID.

1. INTRODUCTION

Computer- based personal identification system also known as biometric computing system that helps to recognize a person by his/her physical or behavioral characteristics. Biometric identification system is growing technology that can be used to solve security problems in our networks society. The technology of palm print authentication was proposed few years ago as a new branch of biometric system, which is based on the extraction of lines and points from palm of a personal for its identification [1]. Biometrics-based personal identification is considered to be an effective way for recognizing person's identity automatically. Biometric computing can offer an effective way for the identification purpose by using individual's reliable, unique and stable physical or behavioral characteristics. There are many techniques based on biometric computing such as physical like finger prints, hand geometry, iris pattern, retina, or behavioral like speech and handwriting. Biometrics-based recognition system is growing as the most stable and reliable solution because it deals with behavioral and physiological characteristics, which can be used to identify and authenticate a person's claim to identify.

1.1 Palm Print Recognition Key Points

The key points in palm print identification are [2, 5]

- 1) To develop an effective algorithm that extracts useful features and

- 2) To correctly measure the similarity between the two features sets.

Feature point extraction-We define as feature points those points lying on the prominent palm lines. For each such of these feature point, the orientation between its associated lines of palm is also computed.

Identity verification- For verification we define two sets P and D for score matching. Where P is used for the percentage of correspondence point that are with respect to the feature points of the two sets which are minimum in numbers, and D is used for the average distance (which is in pixels) between two of the corresponding points. Once the matching sets P and D for the two palm prints has been computed, the identity verification becomes a two-class (genuine v/s imposter) classification problem. The classification task can be treated as constructing a decision boundary in a 2-dimentional feature space (P and D are treated as two features), or some projection method can be applied in order to transform the data into a one-dimensional feature space. We chose to apply a discriminate analysis to the sets of intra-class and inter-class.

There are various technique exist to palm print recognition. There are some researchers have already used different-2 techniques in palm print recognition such as some researcher used PCA for feature reduction and other used LDA for feature reduction.

Our research is to understand these techniques first and then implement a new way for palm print recognition using hybrid techniques.

2. LITERATURE REVIEW

Literature review is an important part of design and implementation of any research work. Proper survey is helpful in the various design phase of the overall system. The significance of the survey lies in the numerous advantages achieved at the time of actual implementation too. A survey deals with the various technological advancement and work done so far in the particular domain. Literature survey is crucial part of any system development project since it allows one to analyze various requirements and probable problems. Survey is very much essential for carrying the advantages of existing systems and simultaneously removing the negatives.

In the last few years, Computer- based personal identification implemented using various biometric techniques in these biometric techniques palm print is also consider an important technique, where extracted lines and points from palms of a person is used for personal identification. Palm has various unique features for identification.

3. PROBLEM DEFINITION & PROPOSED WORK

There are many techniques developed in the literature some of them have been studied in the literature survey now we have to developed a new a technique that is better than other technique and that can handle accuracy and complexity in the system on which we are working.

3.1 Problem Definition and Objective

We have found a weakness in the PCA based palm print recognition system that there algorithm based on the Eigen palm is used to recognize the palm print. This algorithm successfully works on other biometric like face recognition system, but here system cannot handle the complexity and accuracy.

The objective is to increase accuracy of PCA based palm print recognition system. In this technique first we train the system from the palm images and find out similar images from test-set. First thing that is needed in order to do is to have a data set then extract feature from palm images.

3.2 Proposed Work

We can solve the above mention problem by developing a new technique for recognition of palm print. Proposed technique is a hybrid technique for recognition system based on palm print, for this technique first we obtain ROI of a palm print. In this method we choose a fixed region of square size as the palm centre part, which is then divided and aligned into blocks of square for local feature extraction. Instead of scanning square blocks, we scan the complete image starting from left side from index finger and to thumb crossing point, and then select a bottom point of little finger to draw a rectangle in opposite diagonal direction by joining these points and finally crop that image. This processed and cropped portion of image will further

use for matching .After preprocessing the image of palm print extraction of features can be done to match it further. There are two types of algorithms that can use for recognition, first is identification and is second verification. In technique of identification, an individual is recognizes by the system using the search in the templates database of all the users for a best match. Extraction and matching methods feature can be classified into 4-categories- sub-space-based, Statistical-based, Line-based and coding-based. In technique of verification, a person's identity is validates by system using comparison of the biometrically captured data with persons own biometric data templates present in the system database. Process of verification is used typically for correctly recognition; here the aim is to prevent the access of multiple employee/ people using the same identity.

3.3 Proposed Technique

Proposed technique based on ROI (Region of Interest). In proposed technique first we pre-process palm database and after this palm images are converted into binary image to find out effective ROI. For each images we find ROI that is used for matching same input image from database for identification.

There are many possible techniques that can be used for data classification. Principal-Component-Analysis (PCA) and Linear-Discriminant-Analysis (LDA) are two techniques used commonly for classification of data and reduction of dimensions [21]. PCA has some limitation over LDA for feature reduction. Limitations of PCA are solved in LDA.

These are introduction of Techniques for feature reduction.

- 1) Principal-Component-Analysis (PCA)
- 2) Linear-Discriminant-Analysis(LDA)

3.3.1 Principal-Component-Analysis

Principal-component-analysis (PCA) was invented by Karl Pearson in year1901. PCA is a mathematical procedure which involves the transformation of a number of variables with possibly correlated into a number of variables that are uncorrelated is known as principal components that relates to the original value of variables by an orthogonal transformation. This transformation is to be defined in such a manner that its first principal component has variance as high a as possible (accounts variability as much as possible for the data), and each successive component has to show the highest possible variance over the constraint that is to be the orthogonal to the earlier components. PCA is very responsive to the comparative scale for the original variables.

The main advantages of PCA are that the Eigen palm approach that helps in decreasing the database size required for testing images for its recognition. The trained palm images are not directly stored as raw images rather they are stored as their weights which are found out projecting each and every trained image to the set of Eigen palm obtained [12].

PCA has used widely for reduction of dimensions in computer processing. The base vector, that is $bi(x, y)$ are generated from palm print image sets are known as Eigen palm and they have similar in dimension to the dimension of original images and they are similar to palm print in

appearance. Recognition is implemented by a new image projecting into the subspace spanned using the Eigen palm and to classify the palm print by its position comparing in palm space with palm print positions of individuals.

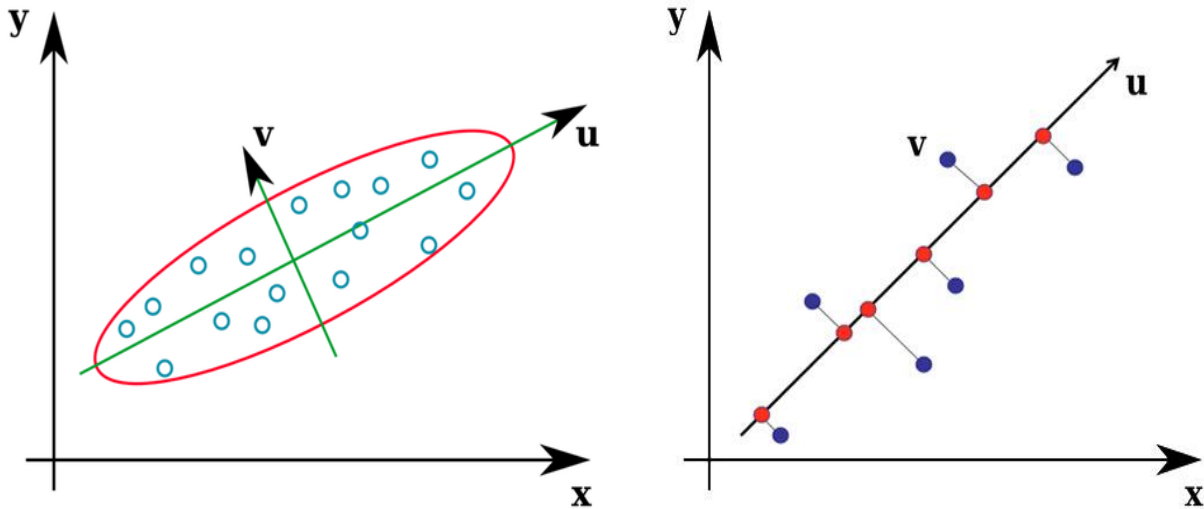


Fig 3.1 (a) PCA for Data Representation (b) PCA for Dimension Reduction

PCA has been widely used in pattern recognition, as well as in the field of biometrics. It is most popular as a face recognition technique but has been also used for the recognition of palm print images. PCA, applied to a set of images, can be used to determine the subspace that is covered with all analyzed sets of images. The images are then encoded into this subspace, and then again returned to their original space, the error between the original image and the reconstructed images is minimized (i.e. no other transform exists that can represent these images with the same number of samples and has a smaller reconstruction error). Thus, PCA finds optimal basis for transform in sense of image representation, but not necessarily recognition the common approach to solving this problem is to reduce the sample dimensionality by means of PCA prior to employing LDA. However, a number of LDA modifications have been developed that don't suffer from this problem, such as regularized LDA (RLDA) and direct LDA (DLDA). Direct LDA solves the problem by removing the NUL space of the matrix SB . RLDA uses the total scatter matrix instead of within-class scatter matrix and adds to it a unit matrix multiplied by some small factor λ , in order to make it non-singular. Independent methods of component analysis to find the underlying factors that generate the observed signals. It is assumed that the observed signals are computed as a linear combination of some independent underlying components. The idea of ICA is similar to PCA, but while PCA finds components that are just uncorrelated, ICA finds components that are also independent (independent components are also uncorrelated, but not vice versa). There are a number of algorithms for computing independent component analysis, with most of them working by maximizing the non-Gaussianity of components [12].

Advantages of PCA

- 1) It is the simplest approach which can be used for the data compression and palm print recognition.
- 2) Operates at a faster rate.

Limitations of PCA

- 1) Requires full frontal display of palm.
- 2) Not sensitive to lighting conditions, position of palm.
- 3) Considers every palm in the database as a different image. Palm of the same person are not classified in classes.

3.3.2 Linear-Discriminant-Analysis

LDA is a well-known method for reduction of dimensions. But for this the Fourier magnitude center band requires to be adjusted. The $k \times k$ for Fourier magnitude the center band can be reshaped to the 2-dimension array that have the same elements as for Fourier magnitude the center band have. The space occupied using the array is known as the Fourier magnitude space (FMS). They generally have FMS dimensionality to be high for directly use. Thus, it requires performing LDA for dimensionality reduction to the array of Fourier magnitude of FMS. When dealing to small sample size data and with high-dimensions, classical LDA undergo to the singularity problem. A common way to solve the problem of singularity is to use an intermediate stage for dimensionality reduction, such as used in PCA [9]. The array of Fourier magnitude is firstly projected as the lesser intermediate dimensional space with the use of PCA that stems from the fact of the intermediate dimensionality can be at most $n-c$, and then standard LDA is performed to the projected samples for processing and the dimension is reduce to at most $c-1$ [13].

Linear-Discriminant-Analysis can handle the case with ease where frequencies of same class are not equal and their result/performances have also been examined for randomly generated set of test data [10]. This method also helps in maximizing the ratio of same class variance to the different class variance for any particular set of data, and thus guaranteeing the maximal separation. The use of Linear-Discriminant-Analysis for classification of data is performed on to problem in classification of speech recognition. In our project we decide to perform the implementation of an algorithm on LDA in order to achieve better classification if

compared to Principal-Components-Analysis. The top most differences between PCA and LDA is that, in PCA it focuses more on classification of feature and in LDA it focuses on classification of data. In PCA, the original data sets shape and location changes whenever it transformed to a different space but in LDA the original data sets shape and location does not changes and it only tries to provide more ability of separation in classes and creates a decision criteria between the given classes. This method also helps to understand the distribution of the feature sets of data in better.

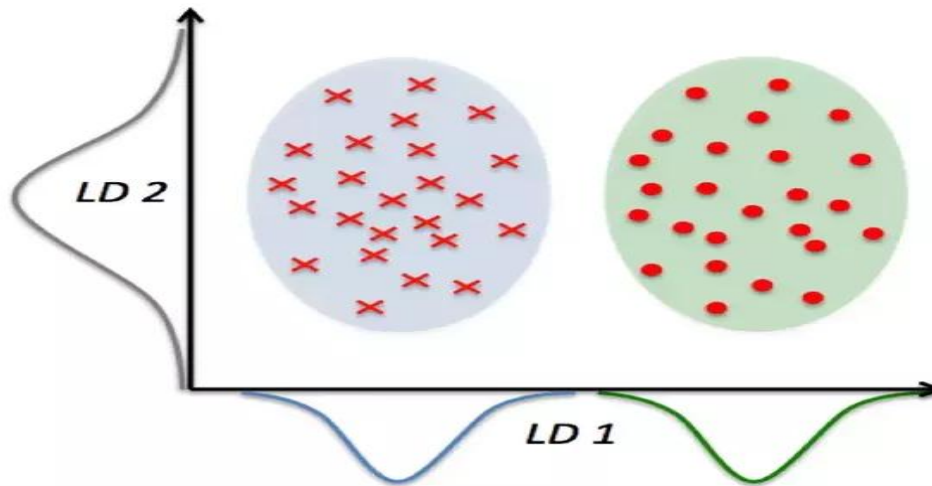


Fig 3.2 Linear-Discriminant-Analysis

Linear-Discriminant-Analysis finds the optimal subspace for recognition in the sense that it maximizes the distance between classes while minimizing the compactness of classes [13]. That is why subspaces obtained by LDA can be more appropriate for recognition than those obtained by PCA.

Data sets transformation and classification of test vectors is possible in the transformed space with two different techniques [14].

- 1) Class-dependent transformation- In this type of approach it involves the process of maximizing ratio between different class variance to similar class variance but the main objective the maximization of the ratio to obtain adequate separation ability of class. The approach of class specific type involves the use of two optimizing way for transforming the sets of data independently.
- 2) Class-independent transformation- In this approach it involves the process of maximization the ratio between the overall variance to similar class variance. Here it uses only one optimizing criterion for the transformation of the sets of data and hence all points of data irrespective of class identity they are transformed with the use of this transform. In this variance of LDA, each and every class is taken as a distinct class against all of the other classes.

- 1) The objective to achieve for LDA is to perform reduction of dimension along it also preserve as much of the discriminatory information as possible for class.
- 2) It seeks to find directions along which the classes are best separated.
- 3) It makes this possible by taking the scatter between same classes into consideration and also the scatter between different classes.
- 4) It is also much capable to distinguish the variation of image because of identification of variation from other sources such as expression and illumination.
- 5) These are basic steps performed by LDA (Linear-Discriminant-Analysis).
- 6) Formulate the sets of data and test that are to be classified for the original space. The given sets of data and the vectors of test are formulated.
- 7) Compute the mean for each set of data and mean of entire set of data.

3.4 Proposed Approach

In our proposed approach, first we preprocess the palm print database to obtain ROI (region-of-interest) because central portion of palm (i.e. palm region) is discriminatory for different person. Then feature of test

What is the goal of LDA?

image and training images are extracted using Gabor filter to perform the best matching of test image, we proposed an algorithm that uses Gabor filter for extraction of feature and then uses PCA.

4. ANALYSIS OF RESULTS

We performed experiment on database of 60 users. Each user has 8 samples of palm. Among these eight samples, five samples are used for training purpose and remaining three are used for the testing purpose. The accuracy for that is Acc is measured by (Accuracy=correct images/ total images) which is 98.05%. Thus, this algorithm works well for the smaller database of palm print images.

4.1 Result Analysis with Table & Graph

Result of our technique is shown by table and graph, which clearly shows the accuracy of palm print base recognition system.

- 1) First we perform this technique on 5 users, each user has 8 samples. Then accuracy of our palm print recognition system was 100%.

4.1.1 Result Table

TABLE 4.1

TABLE OF RESULT

S. No.	Number of user	No of sample/ user	Accuracy
1	5	8	100
2	10	8	99.20
3	20	8	98.76
4	30	8	98.52
5	40	8	98.32
6	60	8	98.12

$$Accuracy = \frac{\text{No of Correct Images}}{\text{Total Images!}} \times 100$$

$$= 98.12$$

4.1.2 Result Graph

- 2) Then next we performed this technique on 10 users, each user has 8 samples and got accuracy 99.20%.
- 3) Then next we increase user and performed this technique on 20 users, each user has 8 samples and got accuracy 98.76%.
- 4) Then next we increase user and performed this technique on 30 users, each user has 8 samples and got accuracy 98.52%.
- 5) Then next we increase user and performed this technique on 40 users, each user has 8 samples and got accuracy 98.32%.
- 6) Finally we performed this technique on 60 users; each user has 8 samples and got accuracy 98.12%.

As we noted that number of user increases then accuracy continuously decreases. So we can say that this technique works on small database and it has a problem with large number of database.

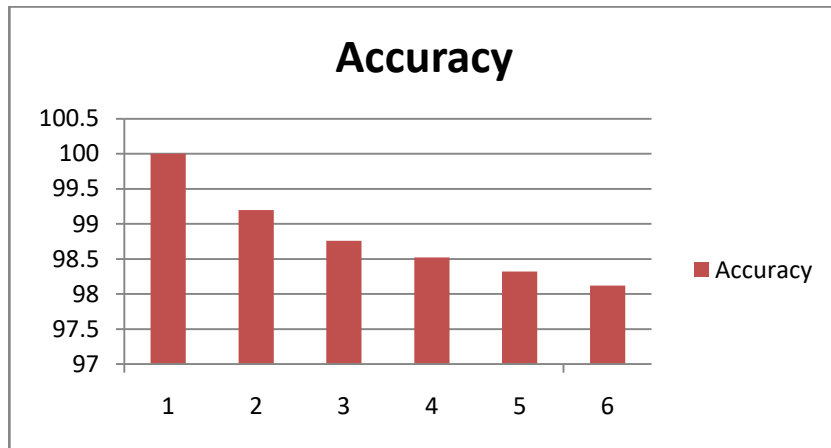


Fig 4.1 Result Graph (Accuracy with increase no of user)

Result graph shows that as no of user increases accuracy continuously decreases.

4.2 Comparison with Previous Algorithm

- 1) Technique proposed in [5] "Improved Palmprint Identification System" gives the accuracy 96% with efficiency above 99% by using DWT + PCA.
- 2) Technique proposed in [6] "Person Identification Using Palm Image Fusion Using Hybrid Wavelet Transform with PCA and EHD" gives the accuracy 95% by using EHD + PCA.
- 3) Technique proposed in [7] "Palm-print-Image-Processing and Linear-Discriminant-Analysis-Method" gives the accuracy 91.3% by using 2DLDA, 94.27% by using 12DLDA and 96.60% by using GABOR+12DLDA.
- 4) Our average accuracy is 98%.
- 5) This algorithm works well for the smaller database of palm print images.

TABLE 4.2

COMPARISON TABLE OF RESULT

S. No.	Method Avg.	Accuracy
1	DWT+PCA [5]	96%
2	EHD+PCA [6]	95%
3	GABOR+12DLDA [7]	96.60%
4	2DLDA [7]	91.30%
5	12DLDA [7]	94.27%
6	PCA [27]	92.40%
7	2D-PCA [27]	92.90%
8	Wavelet [27]	92.20%
9	LDA [27]	93.40%
10	Our Proposed Algo. P-Line GABOR+PCA	98.00%

4.2.1 Comparison with Previous Technique

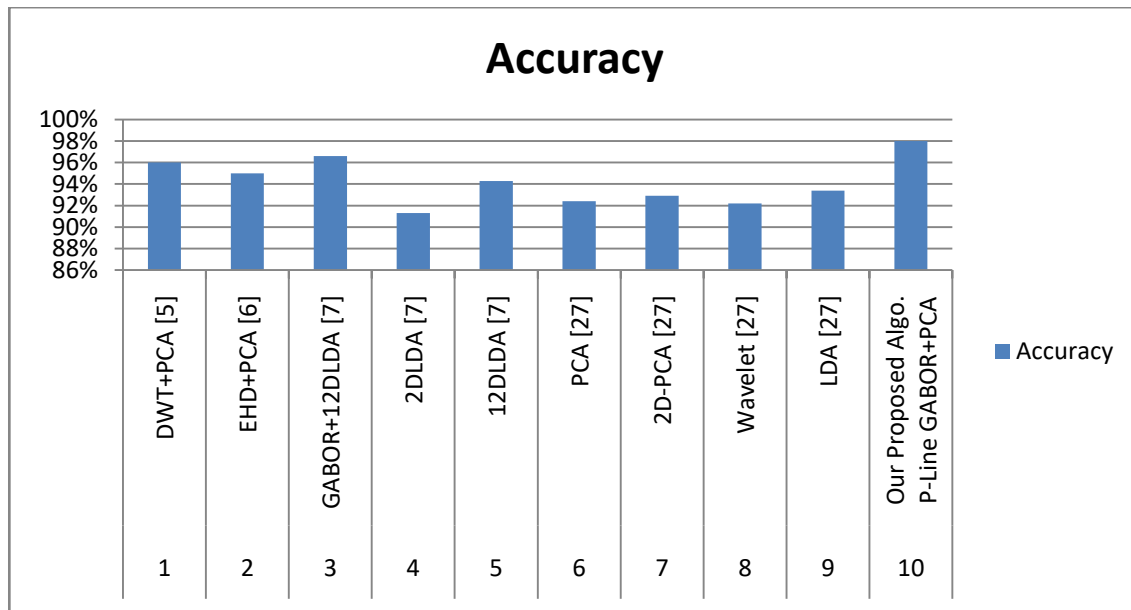


Fig 4.2 Result Comparison with other algorithm

5. CONCLUSIONS & FUTURE WORK

5.1 Conclusion

In this Research we want to develop a new hybrid technique to create a better system for palm print recognition. In previous techniques the complexity of system is more, recognition rate requires improvement and time require for feature extraction and matching also needs to improve, so our developed system is simple and provides better recognition of palm print. In this research we proposed a new hybrid technique that reduces the problem of GABOR and PCA based palm print recognition system by combining the feature extraction of principle lines, GABOR filter and PCA. In this proposed technique first we pre-process the image of palm print because central part of palm (palm region) is discriminatory for different person, then we extract ROI (Region of Interest) and remove other portion of palm area and finally extract features and perform PCA for dimension reduction. After performing this system on 40 users (of CASIA palm-print Database) we observe that our system is simple and gives average accuracy of 98% but time taken for feature extraction and matching needs to improve more.

5.2 Future Work

This system is design and implemented on touch less palm-print database that is most important because it only require an image capturing device like camera, web cam or even a mobile camera to capture palm-print of any individual and the rest can be easily done by our system. There is always possibilities to improve these type of system, so for future following points can be improved to make it more efficient.

- 1) Improve result on large database of palm print images.

- 2) Improve the time requirement of the system for the palm print image database.
- 3) Perform angle correction so that it can detect palm at various angle.

REFERENCES

- [1] S.S. Khot, V.A. Mane and K.P. Paradeshi, "Real Time Palm print Identification Technique-Effective Biometric Identification Technique", International Journal of Societal Applications of Computer Science, Vol 1 Issue 1 November 2012.
- [2] Wenxin Li, David Zhang and Zhuoqun Xu, "Image alignment based on invariant features for Palm print identification", Signal Processing: Image Communication 18 (2003) 373-9.
- [3] Wei Jia, Rong-Xiang Hu, Jie Gui , Yang Zhao and Xiao-Ming Ren, "Palm print Recognition across Different Devices", Sensors 2012,ISSN 1424-8220 12,7938-7964.
- [4] David Zhang, Vivek Kanhangad, Nan Luo and Ajay Kumar, "Robust Palm print Verification Using 2D and 3D Features", Pattern Recognition vol. 43, 358-368, Jan 2010.
- [5] Harshala C. Salave and Dr. Sachin D. Pable, "Improved Palmprint Identification System", International Journal Of Scientific & Technology Research Volume 4, Issue 03, March 2015, ISSN: 2277-8616
- [6] Bhagyashree S. Sawant and Vaishali L. Kolhe, "Person Identification Using Palm Image Fusion Using Hybrid Wavelet Transform with PCA and EHD", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (4) , 2015, 3615-3618, ISSN: 0975-9646
- [7] Shuang Xu and Jifeng Ding, "Paimprint Image Processing and Linear Discriminant Analysis Method",

- JOURNAL OF MULTIMEDIA, VOL. 7, NO. 3, JUNE 2012.
- [8] K. Krishneswari and S. Arumugam, "A Review on Palm Print Verification System", International Journal of Computer Information Systems and Industrial Management Applications (IJCSIM), ISSN: 2150-7988 Vol.2 (2010).
- [9] Nicolae Duta , Anil K. Jain and Kanti V. Mardia, "Matching of palmprints", Pattern Recognition Letters 23 (2002) 477-485.
- [10] Vipin Kumar Jain, "A Tehnique To ROI Of Palm print For Palm line Matching", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 2, Issue 6, November- December 2012.
- [11] Hafiz Imtiaz, Shubhra Aich and Shaikh Anowarul Fattah, "A Novel Technique for DCT domain Palm-print Recognition", International Journal of Scientific & Technology Research Volume 1, Issue 3, April 2012.
- [12] Tee Connie, Andrew Teoh, Michael Goh and David Ngo, "Palm print Recognition with PCA and ICA", Palmerston North, November 2003.
- [13] Dan-Feng Zhu, Hong Wang, Yi-Hai Zhu and Jing Wei, "Palm print Recognition Combining LDA and the Center Band of Fourier Magnitude", ICIC 2009, LNCS 5754, pp. 378-385.
- [14] S. Balakrishnama and A. Ganapathiraju, "Linear Discriminant Analysis - A brief tutorial" Institute for signal and information processing.
- [15] Javier R. Movellan, "Tutorial on Gabor Filters ", Nyasha Dombas Sadomba , Mar 2012.
- [16] Xuewen Wang, Xiaoqing Ding and Changsong Liu, "Gabor filters-based feature extraction for character recognition". Pattern Recognition 38 (2005) 369 — 379.
- [17] V. Shiv Naga Prasad and Justin Domke, "Gabor Filter Visualization".
- [18] Wai Kin Kong, David Zhang and Wenxin Li. "Palm print feature extraction using 2-D Gabor filters", Pattern Recognition 36 (2003) 2339 — 2347.
- [19] Tai Sing Lee, "Image Representation Using 2D Gabor Wavelets". IEEE transaction on pattern analysis and machine Intelligence, VOL. 18. NO. 10. OCTOBER 1996.
- [20] John G. Daugman, "Complete Discrete 2-D Gabor Transforms by Neural Networks for Image Analysis and Compression", IEEE Transaction on acoustics, speech, and signal processing. VOL. 36. NO. 7. JULY 1988.
- [21] A. Kumar and D. Zhang, "Personal authentication using multiple palm print representation-", Pattern Recognition, vol. 38, no. 10, pp. 1695-1704, Oct. 2005.
- [22] Ashutosh Kumar and Ranjan Parekh, "Palm print Recognition in Eigen-space", International Journal on Computer Science and Engineering (IJCSE), ISSN: 0975-3397 Vol. 4 No. 05 May 2012.
- [23] Gayathri R. and P. Ramamoorthy, "Palm print Recognition using Feature Level Fusion", Journal of Computer Science 8 (7): 1049-1061, 2012.
- [24] Jane You, Wenxin Li and David Zhang, "Hierarchical palm print identification via multiple feature extraction", Pattern Recognition 35 (2002) 847-859.
- [25] K.Y. Rajput, Melissa Amanna, Mankhush Jagawat and Mayank Sharma, "Palm print Recognition Using Image Processing", International Journal of Computing Science and Communication Technologies, VOL. 3, NO. 2, Jan. 2011.
- [26] G. S. Lipane and S. B. Gundre, "Palm Print Recognition Review Paper", International Journal of Engineering Trends and Technology (IJE Fr), V4(2) 183-185, Feb 2013.
- [27] Ji Wang, "Multi-spectral Palm print Recognition Based on Linear Discriminant Analysis", International Journal of Advancements in Computing Technology(IJACT) Volume5, Number9, May 2013.
- [28] Sanjay S. Ghodke, Harshad Kolhe, Saurabh Chaudhari, Kedar Deshpande and Somesh Athavle, "ATM Transaction Security System Using Biometric Palm Print Recognition and Transaction Confirmation System", International Journal Of Engineering And Computer Science ISSN: 2319-7242 Volume 3 Issue 4 April, 2014 Page No. 5332-5335.
- [29] David Zhang, "A Comparative Study of Palm print Recognition Algorithms", ACM Computing Surveys, Vol. 44, No. 1, Article 2, Publication date: January 2012.