

# **Palm Biometrics: Echelon of Security**

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**ABSTRACT:** Nowadays, Biometrics identification is a widespread method used for authentication. It is a technology which provides convenient and reliable results after verification of an individual. It uses various image processing techniques and extracts features for verification of an individual with the data stored in database. The purposed system uses Palm Biometrics because it contains enough information as compared to other biometric technologies. The goal of Palm biometric system is to provide security by verifying whether the traits stored in database matches with the questioned image or not. In this paper various innovative steps are covered like introduction related to biometrics is given, palm geometry is described, methodology is diagrammatically explained i.e. the way work has been done, different features are considered here i.e. Edges and Corners of palm. Parameters like miss classification rate, Confusion Matrix and Time parameter which includes CPU Time, Minimum Elapsed Time and Time for Feature Extraction have also been calculated here. In this work, we gathered database of 100 persons varying from age 18 to 50 years and Circular Gabor Filter has been used for Image processing. The experimental results demonstrated that the proposed palm recognition system achieves a recognition accuracy of 98.42% with False Rejection Rate(FRR)=0.78% and False Acceptance Rate (FAR)=0.82%.

**KEYWORDS:** FRR-False Reject Rate, FAR-False Accept Rate, EER-Equal, PIN- Personal Identity Number, SVM-Support Vector Machine.

## **I. INTRODUCTION**

Biometrics refers to the quantifiable data and is based on authentication of human characteristics or traits. Biometrics is used as a tool for verification and access control. It is used to identify individuals in groups that are under scrutiny. Biometric is most secure and convenient tool for authentication. Here, **ECHELON OF SECURITY** is used with Palm Biometrics. Echelon means a body of troops arranged in a line and security is a state of being free from danger or threat. Palm Biometrics System acts as a body of troops which fights for security by verifying whether the person is authorized or unauthorized to use the system.

Biometrics measures and compiles various physical or behavioural features of an individual, so that security can be provided. Verifying identity of an individual is done by scanning physical or behavioural characteristics of an individual. Physical characteristics include Face, Hand, Palm, Iris, Deoxyribonucleic Acid (DNA), Fingerprints, Retina etc. Behavioural characteristics include Signature, Pressing keystrokes, Gait etc.

Biometrics provides an easy way for verification of an individual. It eliminates user to carry tickets, ID cards, passports also user doesn't need to memorize any username or password. This verification has broad applicability and people are being identified using this biometric system like in colleges for attendance purpose, hospitals, forensics and even airports. The main objective of this biometric System is security, so that group of individuals can be identified as authorized or unauthorized. It just compares the questioned image with the image stored in database.

Here, among all the biometric technologies, palm has been chosen. Palm is a linear unit based on the length or width of the human hand. Palm has abundant information that can be used for verification of an individual. Features of palm are quite rich and much wider as compared to fingers. The features of palm are not observable to the naked eye. Also, it has believed that palm print is unique and stable to every individual. So, it can be used for recognition of an individual.

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Biometric System can mainly operate in two different modes. In first step, user has to register himself to use the system. In this process a user will just have to place his hand on the sensor and it will extract the features and store them into database in digital form. This process is called Registration. In second step, verification is done to validate the user.

Time plays a vital role whenever we design any system. Similarly, as here we are designing a Palm biometric System we need to consider the time parameters as well. Time parameters can be divided into Sensor timings and Network timings.

### Total Time= Sensor Time + Network Time

Whenever, user places his hand on the Palm biometric system that palm print will be cross checked with the online database. This total time is considered as **Network Time**. The time taken by Sensor to extract features of palm is known as **Sensor Time**. It is difficult to increase the time taken by Network but Sensor time could be decreased.

## II. PROBLEM DEFINITION

With the evolution of automation and the expansion of new technological systems personal verification is essential in our daily lives. Biometrics technology allows resolving and confirming one's uniqueness through physical characteristics. Biometrics is foolproof form of verification than typing passwords or even using smart cards, which can be crashed. Biometric systems substitute conventional identification methods since these are more suitable and consistent. However, considerable work has been done on Palm Biometrics and few problems have been found in current system those are illustrated below:

- Usage of Pegs

Peg is a kind of pin protruding between the fingers . It has been observed that various biometric systems today also use pegs; no doubt it is being used for providing support. In actual it is creating lot of problems as with the usage of pegs user become uncomfortable and sometimes, the authorized person is declared as unauthorized. These pegs also deform the shape of fingers when user places his hand on the sensor; performance of Biometric system is certainly reduced.

Figure 1 shows pegs of various colours between the fingers .

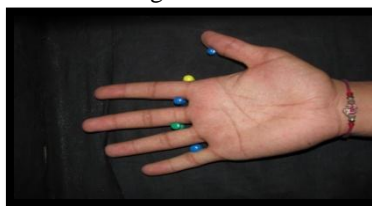


Figure 1: Peg based Scenario

- Offline Database

Database is collection of hand images. Images can be collected offline as well as online. Offline images are static images captured by camera. Offline collection of images causes errors like image clarity, resolution, distance between camera and image should be fixed. To avoid all these problems, online database should be considered for accuracy.

- Accuracy

After survey, it has been found that parameters like datum points, valley points, area, and perimeter are less accurate. We can work on accuracy of the current system used by changing the parameters or the techniques used.

- Translation and Rotation of Palm

It has been observed that orientation of same user on the scanner gives different results which causes mismatch of parameters and the authenticated user declared as unauthenticated. Therefore, to avoid such problem a square wooden strip is kept on flat scanner, a fix point is set on the crossing of thumb and index finger which will avoid translation or rotation of palm.

- Sensor Time

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It has been witnessed that sensor takes extra time while extracting the features. Due to this, user has to wait for that particular time until the result is given whether he is authorized or unauthorized. If the system is taking more time, there is a possibility that an intruder can enter the system while cross checking is done with the database and unauthorized access can be made.

### III. OBJECTIVES

The main objective of work presented is to enhance a hand geometry identification program using MATLAB. Nowadays, many researches are considering Hand geometry for identification of an individual. Palm is a better choice among all other Biometric technologies as it has wider area as well as it rich features like wrinkles, ridges, principal lines, singular points, delta points, creases, and minutiae points. As discussed above, the usage of fingers is a major problem. To avoid this problem, the parameters of fingers can be eliminated. Therefore, in this research work only Palm parameters are considered. The objective of research work is illustrated below-

- To Develop an Iterative algorithm for extracting features of the palm and to remove distortion, redundancy and noise .

Figure 2 shows entire palm image from where features could be extracted and further, can be used for identification purpose.

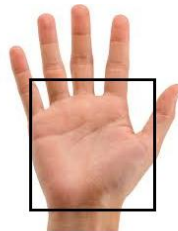


Figure 2: Parameters of Palm

- To develop an algorithm for verification/authentication of an individual using the system.
- To reduce the error ratio and further increase accuracy of the designed system.
- To resolve the difficulty of Translation and Rotation.
- To reduce Sensor Time.

### IV. PALM GEOMETRY

Palm is the inner surface of the hand from the wrist to the base of the fingers. Palm consists of skin pattern and it has many physical characteristics like lines: flexure lines, tension lines, and papillary ridges, wrinkles, points and Texture. Features of palm are unique to each individual and it is not observed with naked eyes. Palm is a better choice among all other Biometric technologies as it has wider area as well as it rich features like principal lines, wrinkles, ridges, singular points, creases, delta points and minutiae points. It has many features of uniqueness, firmness and immovability. Faking a palm is very difficult as compared to fingerprints as this is quite complex procedure. The features of palm are really complicated and it's very difficult to copy those features. Palm is more vigorous to dust and dirt. Although, environmental factors like dust or dryness does not have any negative effects on accuracy of Biometric System. Palm images are available very easily. For recognizing palm prints, simple setup is required. One can use webcam or flat scanner to click the palm images and a simple scanner to extract features of palm. This is the reason for acceptability for palm geometry is high.

Figure 3 shows complete geometry of palm having many features like ridges, curves, texture patterns, wrinkles etc. These features are extracted and used for verification of an individual.

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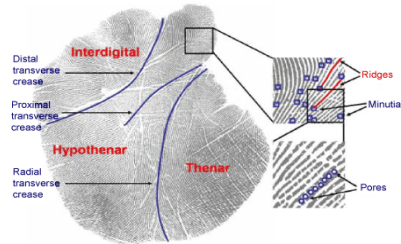


Figure 3: Features of Palm

## V. METHODOLOGY

### A. Modules

Figure 4 shows The designed system has been divided into Five modules and each module is diagrammatically presented and one have a clear view of various transformations

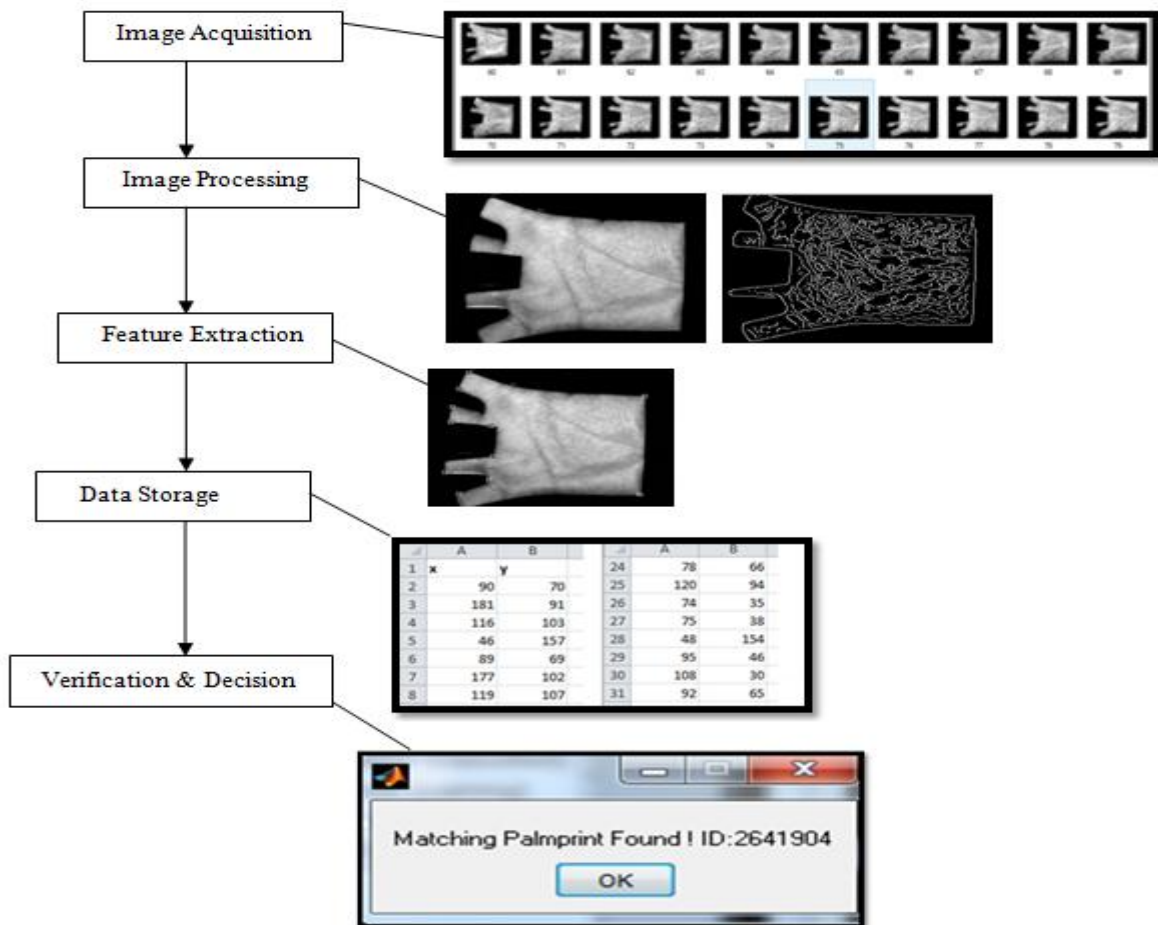


Figure 4: Methodology

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## B. Algorithm

- Step 1: Load Palmprint image.
- Step 2: Calculate edges using canny edge detection
- Step 3: Unique edge points are added to dataset and excel file
- Step 4: Load same Palmprint image for Gabor filterization for pattern like principle lines and texture.
- Step 5: Preprocess image using circular gabor
- Step 6: Gabor\_svm\_palm : to create gabor palm images (100+ images) and calculate sub blocks mean.
- Step 7: Combine step 3 and step 6 to store in dataset and assign id using epoch time.
- Step 8: Check similarity using SVM classifier and plot svm and create confusion matrix.

## C. Calculating Edges and Corners

**INPUT:** Training Samples

**OUTPUT:** SVM is used for training and classification of samples

**Algorithm: Corner Edge Detection**

- 1) Detect edges using canny edge detector.
- 2) Extract Curves .
- 3) Detect and localize corners.
- 4) Mark corners on the edge image
- 5) Mark corners on the original image.
- 6) Write the image.

## VI. RESULTS AND DISCUSSIONS

Database consists of scanned right hand images of 100 users. Volunteers of various age groups are considered here varying from age of 18 to 50 yrs. Here, edges and corners of hand are taken as parameters for verification purpose. Pattern recognition is done with the help of SVM. Various bio-geometric measurements are selected as the parameters which illustrates the co-relation between and among them. It clearly reflects a unique pattern to each subject for authorization and verification of a genuine or imposter entering our system. There are various parameters which defines this biometric system for analysis from authorized and unauthorized person. Main Window is shown in Figure 5.

Figure 5 is the main window and from here one can proceed step by step. Figure 6 shows the first step of Algorithm (B) where palm image has to be loaded for further transformations. Fig 7 shows the Canny Edge Detection result using Algorithm(C).

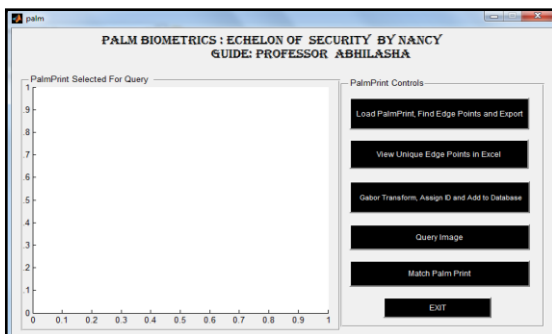


Figure 5: Main Window

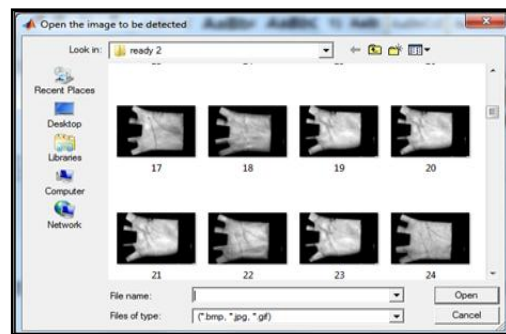


Figure 6: Loading Palm Image

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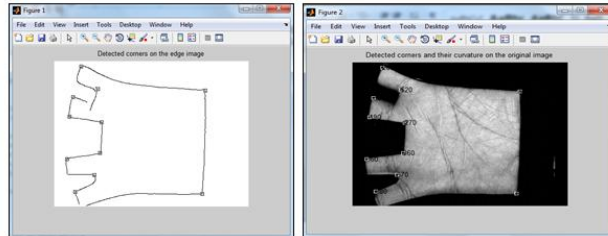


Figure 7: Edge Detection

Figure 8 shows all the points calculated in step 2 will be stored in excel sheet. While Preprocessing Palm images, Circular Gabor Filter has been used to detect various texture patterns and more than 100 images get displayed as a result. Some images are shown in Figure 9. A unique ID will be allotted to each individual as shown in Figure 10.

A	B
x-coordinate	y-coordinate
188	36
82	45
105	41
7	72
34	54
239	92
272	56
241	304
55	309
54	207
54	207
48	179

Figure 8: Dataset

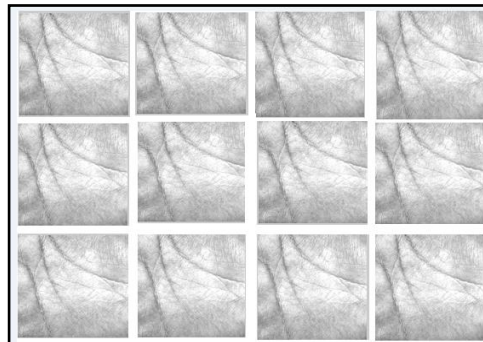


Figure 9: Texture Pattern of Palm

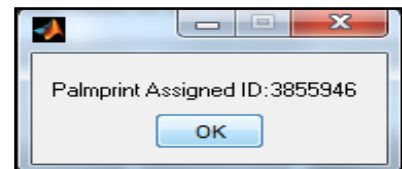
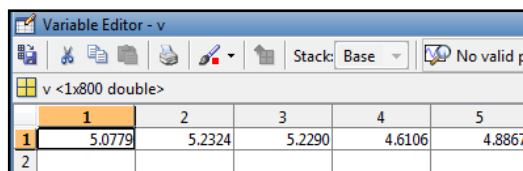


Figure 10: Unique ID's

In the next step, mean of texture patterns has been calculated and stored in database as shown in Figure 11.



	1	2	3	4	5
1	5.0779	5.2324	5.2290	4.6106	4.8867
2					

Figure 11: Sub Block mean

In this research work, Support Vector Machine has been used as a pattern recognition tools. SVM are used as supervised learning models which are basically associated with the algorithms which helps in analyzing data and recognize patterns (shown in Figure 13 & 14). Mainly, SVM is used for machine learning. It performs two functions i.e. classification and regression analysis.



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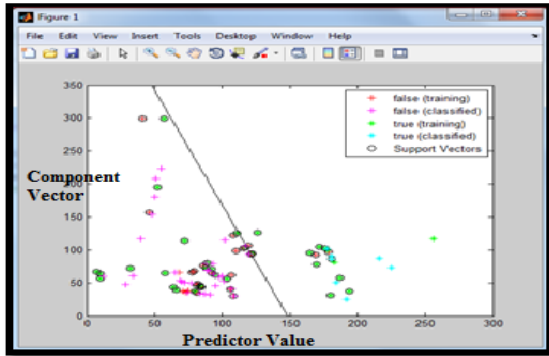


Figure 13:SVM

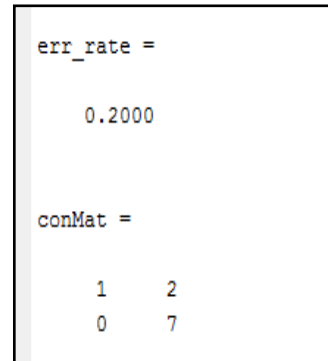


Figure 14: Error Ration & Confusion Matrix

## • Performance

Performance of the biometric system is designed by their accuracy in verification, which is calculated using false acceptance rate and false rejection rate. In this proposed work, a database of 50 images consisting of Training set and Test set is used. Training set consists of 50 genuine samples from known persons. Test set consists of some valid and fraud samples.

For Palm Print Samples: Total Number of Samples=50      Number of Sample that are falsely accepted=9

FAR=Total Number of Samples-Number of Samples Falsely Accepted/Total Number of Samples

**FAR=50-9/50=0.82%**

Total Number of Samples=50      Number of Sample that are falsely rejected=11

FRR=Total Number of Samples-Number of Samples Falsely Rejected/Total Number of Samples

**FRR=50-11/50=0.78%**

Tests are run on dataset of 50 users. Results are reported in the form of FAR and FRR. Accuracy is calculated for new proposed techniques.

Accuracy=100-(FAR+FRR)%

Accuracy=100-(0.80+0.78)%

**Accuracy=98.42%**

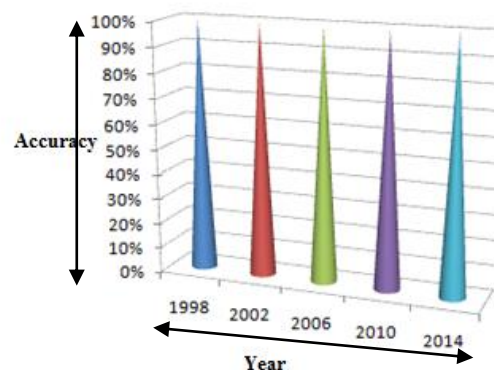


Figure 15: Previous Technique vs Proposed Technique

Figure 15 shows the comparison of previous and proposed techniques which results that our proposed technique gives accurate results than the previous. The accuracy of the system is approximately which is better than the other systems.

## • TIME PARAMETERS

Table No: 1 shows average results of various time parameters calculated on I3 processor.

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Table No1: Average Result

SNo	CPU Time(sec)	Minimum Elapsed Time (sec)	Time for Extracting Curves(sec)
1	0.936	0.034219	0.0381
2	0.0312	0.034219	0.0169
3	0.0312	0.038497	0.0203
4	0.0312	0.034219	0.0174
5	0.0312	0.034219	0.0154
6	0.0156	0.038497	0.0189
7	0.0936	0.038497	0.0282
8	0.0312	0.034219	0.0171
9	0.0156	0.034219	0.0157
10	0.0156	0.034219	0.0203
Average	0.12324	0.035502	0.02083

## VII. CONCLUSION

In this research work, a biometric system has been designed which is based on peg free scenario but at the same time is dependent on constraints or platform where, a user can place his/her hand and verification can be done whether he is authorized or unauthorized person. The system is experimented with 100 users. Designed system extracts the edges and corners features of palms users and stores as a template for further verification. When any user uses this system, features are extracted and cross checked with the features stored in database and hence, verification can be done. The designed system calculated various parameters like miss classification rate, confusion matrix; Time i.e. Minimum Elapsed Time, CPU Time, Time for Feature extraction. Performance of proposed system has been calculated using FAR and FRR and accuracy of 98.42% has been obtained.

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- Database: Hong Kong polytechnic university