Survey of Advanced Palm Print Based Biometric Recognition Systems

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ABSTRACT: From the last few years, the area of biometric has become a point of interest of many researchers. This area concentrates on automatic recognition of human beings based on their physical or behavioural characteristics. It is helpful in many applications for providing authentication and security of organizations. Among these biometric recognition systems, palm print is one of the successful methods for human identification. Palm print is nothing but the patterns of lines located on palm area. Human being is uniquely identified with their palm prints, because it has various unique attributes such as color of palm, clarity of lines, their intensity, position, length, and thickness of various lines etc. Image processing plays very important role in the palm print based biometric recognition system. This system basically works in some commonly knowing steps like, scanning of palm, pre-processing, feature extraction and finally matching of palm in database. There are various algorithms has been developed for the same. This paper makes survey of some recent and advanced palm print recognitions systems and their comparative analysis on the basis of technique used, and their respective advantages and disadvantages. This paper also describes the performance metrics of such system. Finally, some future directions are also discussed..

KEYWORDS: Print; biometrics; authentication; identification; privacy; image processing

I. INTRODUCTION

A pattern-recognition system is used for identification or verification of users based on their unique physical properties. Biometric systems serve various kinds of advantages than traditional authentication methods like ID card systems. In traditional verification or authentication systems, passwords or ID cards have been allocated for users to identify them uniquely. Such methods are includes in various applications including, border security, airport security, time or attendance control, security of restricted areas, online banking, online web applications etc. But such huge rage of recognition methods has several disadvantages. Such passwords or ID cards are not too much secure at all. It can be easily modify by outsiders. This will arise the need of improved and high security techniques in recognitions oor verification systems. This has been resulting in biometric related systems.

Biometric is thebmost secure authentication tool among traditional authentication system. Biometric based recognition systems are popular in the personal identification or verification applications. Biometrics is broadly classified into two types named as behavioural biometric and physiological biometric. Physiological biometrics are more reliable than behavioural biometric.

- Physical Biometric: Finger print, Palm print, Facial, Iris, Hand Geometry.
- Behavioural Biometric: Signature, Voice, Keystrokes.

This paper focused on palm print based biometric recognition or authentication systems. Palm print recognition needs the palm of person as a bio-metric. By using this palm, person is identify or verify uniquely. Palm print is very reliable and secure biometric. It also requires minimum support from the user for palm scanning. Palm print is easily obtained by using low resolution devices. Palm prints contain very important features for identification. These features are principal lines, wrinkles and ridges which are depicted in figure 2 (b). Also, these systems do not require any personal amount or information, therefore it is more secure.

The working of Palm Print based biometric recognition system is depicted in figure 2. It works in following steps:

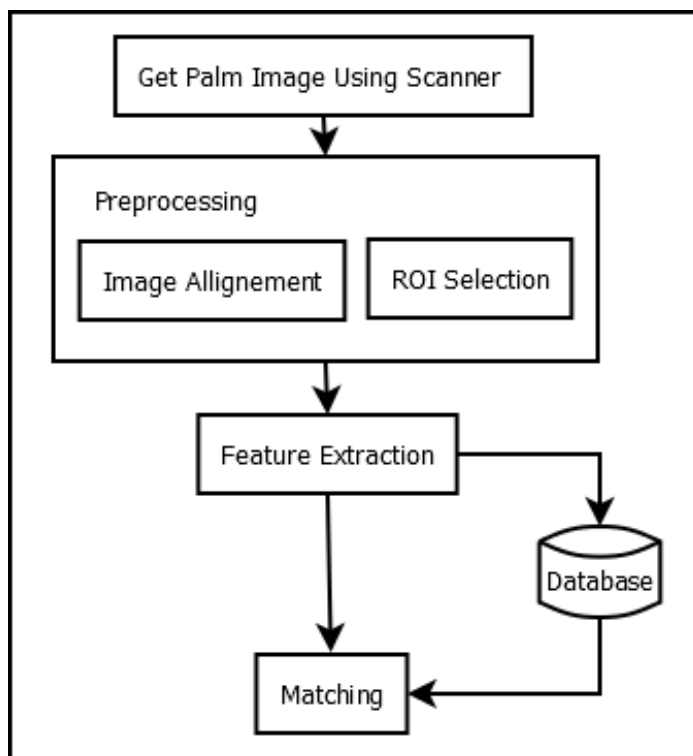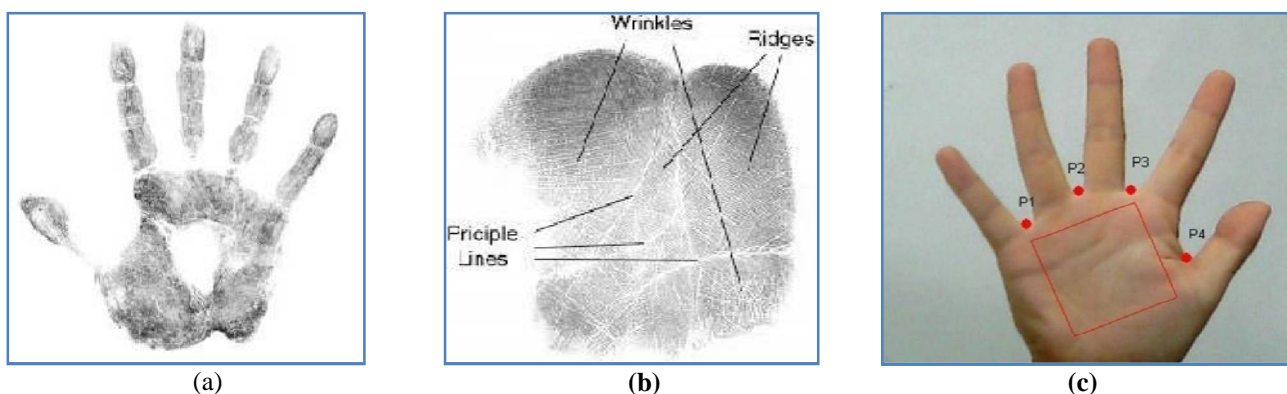Fig.1. Basic Steps of Palm Print Recognition System

(a)   (b)   (c)

Fig.2. Detail description (a) Scanned Palm Print Image, (b) Palm Features, (c) ROI [2]

Step 1: Palm Image Acquisition
   For this, Palm Scanners are required to scan the user's palm. This will give digital scanned palm of users. Various devices are available in market to scan the palms.

Step 2: Pre-processing

In pre-processing, the unwanted part of the scanned image is removed also improve the resolution, to extract more correct features. Pre-processing works in two steps such as:

i.   Image alignment: Edges of palm are extracted and background of scanned palm image is removed in this step.
ii. Region of interest (ROI) selection: In this step, ROI is selected or cropped. ROI is nothing but the palm print image from the whole hand image.

Step 3: Feature Extraction

Feature extraction is conducted on ROI of palm. Various features are extracted such as color of palm, clarity of lines, their intensity, position, length, and thickness of various lines, etc. In short this step extracts the compact representation of the particular palm image. These features are then stored in a database for further identification step. Various feature extraction techniques are available to extract the palm features.

Step 4: Matching

Finally, matching is conducted on a palm print database for authentication of users. In this, current palm input,compares with templates stores in a database on the basis of some threshold. If both satisfy the threshold, then input is identified that is verification is done successfully. Otherwise, this new palm is stored as a new template is a database.

Performance Metrics:

The performance of palm print based biometric recognition systems is measured in terms of following parameters:
i.   False acceptance rate (FAR):
It is the ratio of the number of unauthorized users accepted by the biometric system to the total of identification attempts made.
ii. False rejection rate (FRR): FRR is the ratio of the number of the number of authorized users rejected by the biometric system to the total number of attempts made.
iii. Equal-Error-Rate (EER):
It is defined as the rate at which the FAR is equal to the FRR. In a top security system (e.g. an airport, bank) the FAR value must be minimum or zero, which might lead to a high FRR value.

II. RELATED WORK

Ridge features based palm print recognition and authentication system is proposed in [2]. This palm print recognition system is efficient as well as low computationally complex because of ridge features. It increases the matching speed and accuracy. The features extracted by this system are orientation field and region mask. In matching step, minutiae extraction and cascade filtering technique is used, which increase the matching speed. Overall this system is efficient and accurate.

Biometric Palmprint Recognition is a latest and promising technology. It has many advantages including liveness detection, difficult to forgery etc. A general palmprint recognition system is proposed in [3]. This technique is based on Quadtree decomposition. With Quadtree decomposition, discriminating features can be easily obtained in palmprint recognition process, which will improve the accuracy of system.

A personal recognition system is presented in [4], which based on the central part of hand. The System makes use of 2D Gabor filter for feature extraction and then apply Principle Component Analysis (PCA) along with LDA for dimensionality reduction process. Finally system applies Euclidean distance on a reduced set of palm print features for their classification. The performance of the system is tested on IITD and CASIA databases and prove that system achieves 91% of accuracy with high true recognition rate and computation time.

A multimodel biometric recognition system based of SURF algorithm is designed and developed in [5]. This system makes use of palm vain and palm print images, which are preprocessed with adaptive histogram equalization method. For feature point extraction, SURF algorithm used in case of image translation, scaling and rotation. Finally, test

images are classified with database images by using distance methodology. This system achieves 0% of false acceptance rate and 1.92% of false rejection rate.

Scattering Wavelet Transform (SWT) based palm print recognition system is proposed in [6]. A novel approach for the region of interest extraction is proposed and then SWT is applied for feature extraction. It will enhance the matching accuracy. Finally a Euclidean distance formula is used to compare the test image features with database features to perform the matching. The output is not affected due to varying degree of rotations and translations.

OMAP3530's development tool DVSDK is used for palm print recognition system in [7]. This system makes use of various techniques such as, Wavelet reconstruction, local DCT and 2DPCA. For OMAP3530, multi-core digital signal processing chip is required.

Person identification technique based on their hand or palm print image is proposed in [8]. Two types of features are used for biometric recognition and identification such as palm print features and palm geometry features. Palm geometry features are extracted by using 16 pointed marker and palm print features are extracted by using Palm ROI. System performance is tested on a database of 300 palm images of 50 different users. The system achieves good performance with 2.67 % of false rejection rate, 0.71 % of false acceptance rate and 97.37 % of genuine acceptance rate.

Following table I describe the comparative analysis of some recent approaches as described above. Approaches are compared on the basis of following parameters:

- Paper Title / Year
- Feature Extraction Technique
- Matching Technique
- Results
- Research Gap

TABLE I
COMPARATIVE ANALYSIS OF VARIOUSAPPROACHES

Sr. No.	Paper Title / Year	Feature Extraction Technique	MatchingTechnique	Results	Research Gap
1.	A New Hybrid Approch for Palm Print Recognition inPCA Based Palm Print Recognition System (2016) [1]	Gabor Filter, PCA, 2D-LPF	KNN Classifier	98% of accuracy with less complexity in recognition of palm print	This research is done on small database.
2.	An Efficient System for Palm Print Recognition using Ridges (2014) [2]	Minutiae extraction	cascade filter	With ridge features reduce the computationalcomplexity and hence to increase the matching speed and accuracy	Does not supporting to partial palmPrints
3.	Quadtree Decomposition for Palm print Feature representation inPalmprint Recognition System (2012) [3]	QUAD TREE DECOMPOSITlON	Thresholding method	provides a schema for dimensionalityreduction, hence, improving the processing time for edgedetection	does not address the problem ofnoise reduction
4.	Texture based Palm Print Recognition using 2-D Gabor Filter and Sub pace Approaches (2015) [4]	2D Gabor filter, PCA and LDA	**Euclidean Distance**	higher accuracy (91%) in terms of correct recognition rate and low computation time.	This work can be extended by focusing on more robust palm print features, sothat a highly secure hand based biometric system can be designed.
5.	Stockwell transform based palm-print recognition (2011) [9]	Stockwell Transform	nearest-neighbour approach	system performs with CRR of 100%for all datasets and at EER of 0.96% for IITK database, while EER of1.16% and EER of 0.0055% for CASIA and PolyU databases respectively.	System can be extended with better classification algorithm for matching step

III. IDENTIFIED FUTURE DIRECTIONS

Some Benefits of biometric systems are: [10]

- Identification integrity
- Information integrity
- Increased security
- Secure information access
- Accurate access statistics
- Reduced costs
- No password maintenance
- Fraud detection/prevention
- Convenient

From this survey, we have identified some research challenges in biometric recognition system:

- System should be tested on real time large volume of database, to improve the accuracy of system.
- System should support complete palm image or partial palm image, to accurately perform verification or authentication.
- Reduce the cost of pre-processing and focused on high resolution images.
- System should extract more robust palm print features to improve the accuracy and efficiency.

To improve the performance of system, proper features extraction and classification algorithms should be selected.

IV. CONCLUSION

From this survey, we conclude that the palm print plays very important role in biometric recognition systems. Palm lines are the most important features of palm to verify or identify the person uniquely. On the basis of these unique features, most of the researches had developed some computer based automatic recognition systems. Initially this paper describes the basic architecture of the palm print recognition system and detailed description of each step. After this, various recent papers are studied and explained one by one here, such as:

- Paper title
- Feature extraction technique used
- Algorithms used for matching
- Advantages or results
- Research gap of each technique.

Finally paper describes some identified feature direction, which can be usefull for further enhancement in the same research field.

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