A Novel Approach of feature extraction in Palm Print Recognition System

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Abstract

Biometrics is the area where person's identification can be done with its own physical or behavioral characteristics like face, finger print, palm print, retina, voice, signature etc. Palm print is rich in features like lines, texture, hand geometry which is unique for each individual. This paper enlightens the idea how effectively these features can be used for identification of the persons. Many methods are used to find principles line wrinkle and texture. This paper gives the detailed knowledge of conventional 2D-Gabor filter, sobel operator, Discrete Wavelets Transform, Discrete Fourier Transform and non-conventional methodologies like Nature inspired algorithm and deep learning Neural Network.

Keywords: Nature inspired algorithm, swarm intelligence, Particle swarm optimization, Ant bee colony algorithm, Deep learning neural network.

1. Introduction

Biometrics is the art of establishing the characteristics of any person based on the physical, chemical or behavioral attributes. Biometric authentication offers a natural and reliable solution to the problem of establishing identity of a person utilizing physiological or behavioral biometric characteristics. The need of biometrics in present society has been required for large scale identity management systems, which is based on the accurate identification of an individual's identity. Traditional method of establishing a person's identity includes knowledge based or token based methods but those methods can be lost, shared, manipulated or stolen [1]. The main motivation of biometrics system is based on cost, user acceptance, environment constraints, accuracy, computation speed and security [2]. Biometrics offers a natural and reliable solution to certain aspects of identity management by utilizing fully or semi automated scheme to recognize any person's biological characteristics.

Biometrics characteristics are hand based geometry, finger print, palm print, vein structure, iris, retina, face, voice, signature, DNA, dental and typing key pattern.

A standard biometrics system may consist of the following four stages:

i. Data acquisition: input device is used for biometric data.

ii. Image preprocessing: after input images are used for preprocessing includes enhancement of the input image like segmentation, noise reduction, translation, rotation, normalization.

iii. Feature extraction: features defined for unique and stable properties of low and high inter class differences it will create master template.

iv. Feature matching: a matching factor is calculated by matching the identification score against master.

The different modes of standard biometrics system are enrollment, identification and verification modes. Enrollment is performed with template after that identification mode is done with enrolled image.

Factors for verification of any biometrics pattern is FAR (False Acceptance Ratio) is the value in which non registered user gain access to biometrically protected system, FRR (False Rejection Ratio) is the ratio in the situation where register user fails to gain rightful access to biometric protected system, EER (Equal Error Ratio) is the percentage where Acceptance Ratio and False Rejection Ratio are the same. Apart from many biometrics all are having its own advantages and disadvantages. Palm print is one of the latest area of research with its unique and robust features [3].

Palm is the inner surface of our hand from the wrist to the root of fingers. A Palm Print is the skin pattern of a palm, composed of the physical characteristics of the skin pattern such as line , point, and texture [4] which shown in Figure 1.
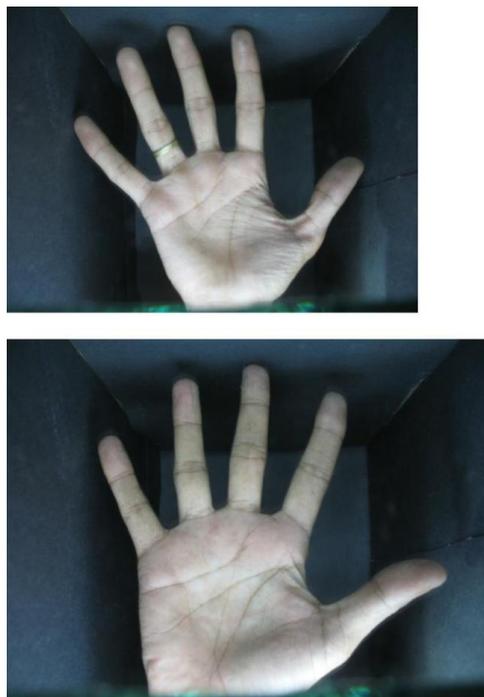

Figure 1. Palm print image sample

Palm print authentication is a means of personal authentication that uses unique palm print features which cannot be easily measurable. It can be achieve by designing an appropriate algorithm capable of separating two persons by their palm print patterns. One of the reasons of catching researcher's interest is that palm print is rich in features like Principle lines (heart line, life line), wrinkles, ridges, singular points and minutes point. It has larger area for feature extraction [5].

Palm print biometric authentication system having applicability features as shown in Table 1, which gives better performance are as follows [4]:

a. Universality: each person should have the features.

b. Uniqueness: no two people should be the same in term of the characteristics.

c. Permanence: characteristics should be unchanging over the long period of time.

d. Collectability: characteristics should be quantitatively measurable.

e. Performance: accuracy and speed of the identification and robustness of the system.

f. Acceptability: extent to which people are willing to accept a particular biometric identifier in their life.

g. Circumvention: how easy to make fake system

Table 1. Comparison of different biometric identifier where High Medium and Low is written as H, M and L[6]

Biometric identifiers	Universality	Uniqueness	Permanence	Collectability	Performance	Acceptability	Circumvention
DNA	H	H	H	L	H	L	L
Ear	M	M	H	M	M	H	M
Face	H	L	M	H	L	H	H
Facial Thermo gram	H	H	L	H	M	H	L
Fingerprint	M	H	H	M	H	M	M
Gait	M	L	L	H	L	H	M
Hand Geometry	M	M	M	H	M	M	M
Hand Vein	M	M	M	M	M	M	L
Iris	H	H	H	M	H	L	L
Keystroke	L	L	L	M	L	M	M
Odor	H	H	H	M	H	L	L
Palm print	M	H	H	M	H	M	M
Retina	H	H	M	L	H	L	L
Signature	L	L	L	H	L	H	H

Traditional application of palm print are fortune reading or health diagnosis but now palm print biometrics are used in personal identification, authentication, security based on its lines texture and points. Figure 2 shows the standard stages of palm print recognition system.
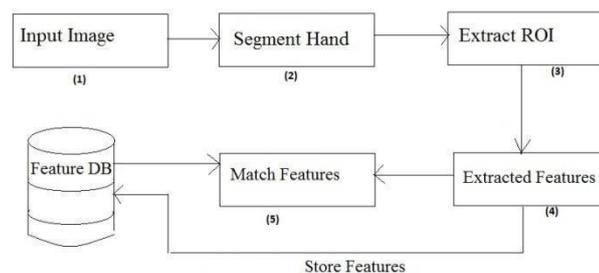

Figure 2. Standard stages of Palm print recognition system [6]

palm print research can be done with two types of images like high resolution image and low resolution image. High resolution images extracts ridges, singular points and minute's .These are used for forensic application like criminal detection. Low resolution images extract principle lines, wrinkles or texture. These are used in commercial applications or access control applications [2]. The types of palm print are shown in Figure 3.
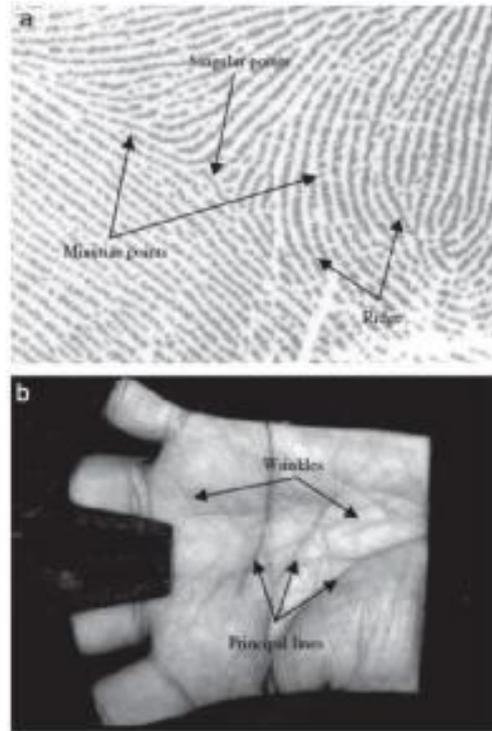

Figure 3. Palm Print features in a. a high resolution image and b. low resolution image.

The rest of the paper describes the different methodologies to find which method is better.

2. Literature Review

D. Zhang, Wong, You in his paper [7], considers the palm print as a piece of texture and apply texture-based feature extraction techniques to palm print authentication [2]. A 2-D Gabor filter is used to obtain texture information and two palm print images are compared in terms of their hamming distance.

D. Zhang, Kong, Wong and You in their paper [8] presents a new biometric approach to online personal identification using palm print technology. in this paper online palm print identification system employs low-resolution palm print images to achieve effective personal identification. 2D. Zhang and Shu [9] in this paper, two novel characteristics, datum point invariance and line feature matching, are presented in palm print verification. The datum points of palm print are defined and their determination using the directional projection algorithm is developed. Then, line feature extraction and line matching are proposed to detect whether a couple of palm prints are from the same palm.

Some of the subspace methods like Principal Component Analysis (PCA), Linear Discriminate Analysis (LDA) and Independent Component Analysis (ICA) are the techniques adopted in the literature [10] for feature representation and also in dimensionality reduction.

Anil k. Jain in his paper[6], characterize user's identity through the simultaneous use of three major palm print representations and achieve better performance than either one individually.

Different Sobel operators are applied [11], [12] to the resized palm print image. The Sobel image is threshold and represented using feature vector. All of the feature vectors are compared using Hamming Distance similarity. An accuracy of 94.84 % can be achieved using the proposed method.

a deep architecture model [13] for palm print recognition implemented as a stack of RBMs at the bottom with a regression layer at the top, DBN is effective for feature learning with unsupervised training and supervised training. Compared with traditional methods (PCA, LBP) [14].

3. Methodology

3.1 Nature inspired algorithms: Nature is the great source of inspiration to solving meta-heuristic algorithm. A era of problem solving algorithm proposed which is inspired with the nature. These are the collective behavior of decentralized, self organized system natural or artificial. Algorithm works based on the simple agents interacting locally with one another through the environment [15].

Swarm Intelligence is also involve in Nature inspired algorithms. Examples of such algorithm are ant colonies, bee colonies, birds flock, particle swarms, fish schools, bacterial growth [16].

Particle Swarm Optimization Algorithm: PSO is the global optimization algorithm proposed by Kemedy Berhart and Shi for dealing with problem in which a best solution can be represented as a point or surface in an n-dimensional space [17].

In PSO each particle is equivalent to the bird they constantly update their position and speed and achieve the optimal solution through continuous iteration and determining its own position and the quality of velocity by two "extremes" values in each iteration. The first extreme value is the optimal solution found by the particle itself called personal best and another extreme is the optimal solution found by the entire population currently called the global minimum.

PSO is used to handle non-linear optimization problem, non-differentiable and complex multi peak function.

The Solving process of PSO starting from random solution through iterative calculation to find optimal solution.

Ant Bee Colony (ABC) Algorithm: ABC is a new SI algorithm inspired by the working behavior of honey bees[18]. In this algorithm there are three types of bees, employed bees, Onlooker bees and scout bees. Employed bees search food around the food source in

their memory parallel they communicate information about food source with the Onlooker Bees. Higher quality food source is selected by the Onlooker bees, when the good food quality not improved with the current cycle then Scout bees are transformed by some employed bees, which dispose of food source and start new one.

ABC algorithm mathematically derives with the following equations [19].

$X_{ij} = X_{j1} + rand(0,1)*(X_{j2}-X_{j1})$

Where Xi= (Xi,1 , Xi,2 ,.. Xi,d) for dimension d

i=(1,2,…Sn) and j=(1,2,..d)

Xj1= Lower bound

Xj2 = Upper bound

Onlooker Bees evaluates the nectar information taken from all employed bees and choose a food source with the probabilities with the following equation:

The position of the ith food source solution can be expressed

$$Pi = \frac{fit(xi)}{\sum_{i=1}^{Sn} fir(xi)}$$

3.2 Deep Learning Neural Network: Deep Learning Neural Network defined as neural network architecture that can facilitate deep learning retrieval and analysis of data that is deeply buried in input information and not easily retrievable[13]. Deep learning proficiently solved some problem like image recognition, speech recognition, pattern recognition and machine learning.

The concept of deep learning comes from machine learning. Palm print recognition system can also be use this new concept as the work done in [14].

4. Conclusion

This is the study of conventional and non-conventional methodology for extraction features in palm print recognition system. The study Enhancement of the result can be better performed with latest methods like Nature inspired and deep learning neural network. These methods are new approaches to solve the problem proficiently. As we find so many work can be done with palm print biometrics. Both Conventional and nonconventional methods are used. In order to improve the performance of the system Nature inspired algorithm and deep learning methods can be improved by fusion traditional methods.

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