STATE OF ART: HAND BIOMETRIC

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ABSTRACT

This paper present a state of art about biometric hand, different techniques used.Biometric is essentially used to avoid risks of password easy to find or Stoll; with as slogan save Time and Attendance. We can note that biometrics is a true alternative to the passwords and other identifiers to make safe the access controls. It makes it possible to check that the user is well the person who it claims to be.

KEYWORDS: *Hand, palmprint, geometry, biometric system, identification, authentification, verification.*

I. INTRODUCTION

Biometrics is in full growth and tends to join other technologies of safety like the smart card. Within the biometric systems used today, we notice that the hand biometric is one of those, the users most accept because they don't feel persecute in their private life. A survey of 129 users illustrated that the use of hand geometry biometric system at Purdue University's Recreation Centre has many advantages; the survey participants, 93% liked using the technology, 98% liked its ease of use, and specially more no else find the technology intrusive [KUK06].

It's why; nowadays hand biometrics recognition has been developed with a great success for the biometric authetification and identification. The biometric recognition process allows the recognition of a person basing on physical and behavioral features. Because of each person have characteristics which are clean for him: voice, fingerprints, features of his face, his signature... his ADN and by the way hand physionomy and physiology, an overview of such systems can be found in [ROS06].The hand is the almost appropriate for some situations and scenarios.

For the hand biometric modality, within the main features used; we note: the length and width analysis, the shape of the phalanges, articulations, lines of the hand …etc

The hand biometrics presents a high ease to use a system based on. Although, the hardware system from time to time makes error incidence's due to the injury of the hand and by the way the hand age. Setting besides that, the systems gives a very high accuracy with a medium security level required. However, for a long term the stability is somehow average and need to be improved. Most of the previous works has elaborated systems based on hand biometric contact [SAN00].

The reminder of this paper is organized as follow. In section 2, we present why we use the hand biometric. In section 3, we describe how does hand biometric system works. In Section 4, we present the hand identification techniques. In Section 5, we present the bottom up feature based methods. In section 6, we present the data capture. In Section 7, we present the hand biometric identification/ authentification. In section 8, we present a tabular representation of the existing method. In last section, we offer our conclusion.

II. WHY HAND BIOMETRIC?

The suitability of a specific biometric to a particular application depends on many issues [50]; amid them, the user acceptability appears to be the most important [JAI97]. For various access control

applications, as immigration, border control and dormitory meal plan access, very distinctive biometrics, e.g., fingerprint and iris, could not be suitable for protecting person's privacy. In such circumstances, it is preferable that the given biometric key be only unique enough for verification but not for identification. The evaluation of a biometric method depends on the reliability, security, performance, cost, user acceptance, life detection, users, size of sensor. One of its advantages is the aging issues, both young and old.

III. HOW DOES HAND BIOMETRIC SYSTEM WORK?

A hand biometric system works like the other systems based on the other modality as fingerprint, voice, iris… Maybe, it can differ only in some few points, like the way to make safe the information. But, generally the scenario bellow (Fig. 1) is used to conceive a hand or another biometric system:

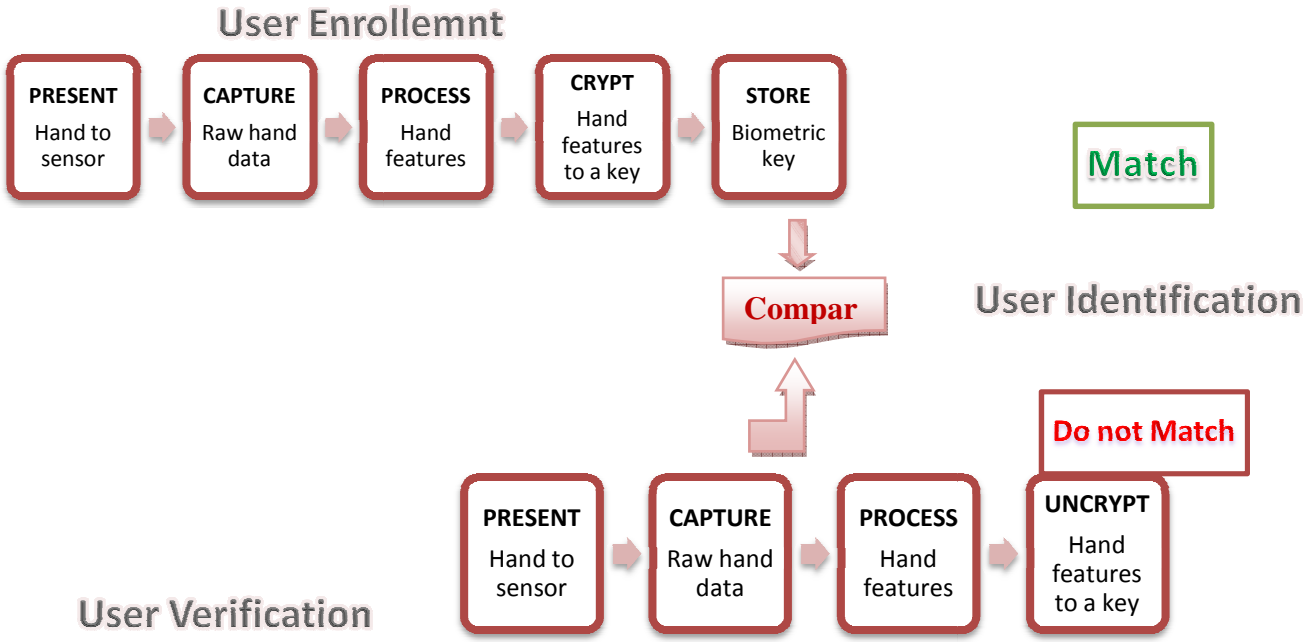

Figure 1 Hand biometric system scenario's

It is based on three basic processes; the enrolment, the verification and the identification. The enrolment phase is used for Adding a biometric identifier to the database. The Verification, more known as one towards one, because it must make sure that the person is whom he/she claim to be by matching against a single record. The Identification, more known to as one against all, since it ought to find who is this individual through a matching against all the records in the database.

IV. HAND IDENTIFICATION

There are three clusters of characteristics which are used in hand identification, which are called, too bottom up features:

- Geometric features; such as the width, length and area of the palm. Geometric features are a rough measurement and they are not sufficiently distinct;
- Line features, principal lines and wrinkles. Line features identify the size, position, depth and length of the various lines and wrinkles on a palm. Although wrinkles are very characteristic and are not easily copied, principal lines may not be satisfactorily distinct to be a reliable identifier;
- Point features or minutiae. Point features or minutiae are similar to fingerprint minutiae and classify, between other features, ridges, ridge endings, bifurcation and dots.

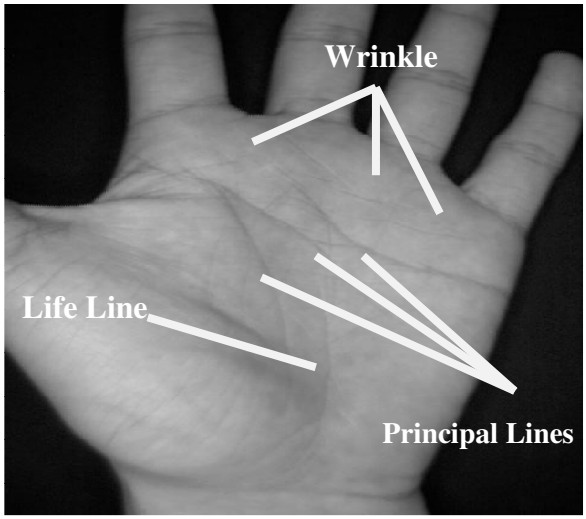

Figure 2 : Hand's Lines

V. BOTTOM-UP FEATURE-BASED METHODS

The human hand is the source of a number of unique physiological characteristics. The main technologies for hand recognition fall into three categories: palmprint technologies – those measuring the unique pattern of prints from the palm of the hand – similar to a fingerprint; Hand geometry measurements – those measuring the shape and size of either all or part of the human hand or fingers; Hand vein patterns – those measuring the distinct vascular patterns of the human hand, including hand dorsum vein and palm vein.

5.1. Palmprint features

They are made up of principal lines, deltapoints, minutiae, wrinkles, singular points and texture,etc…[32] .Several approaches are used for. Within the most popular methods, those considered the palmprint images as textured images which are sole for each person. [9] apply gabor filter for palmprint image analysis using a digital camera where [11] used the wavelets, [16] the Fourrier Transform, [44] the local texture energy and [41] the directional line energy features. Therefore, [DUT03] used a set of feature points the length of the major palm lines. Though, in palmprints the creases and ridges often overlie and cross each other. So, [3] has putted forward the extraction of local palmprint features by eliminating the creases; but this work is only limited to the extraction of ridges. Where [45] by generating a local gray level directional map; has tried to approximate palmprint crease points.

Generally the steps used for the palmprint based biometric are; first to align and localize palm images by detecting and aligning to inter-finger anchor points: index-middle and ringpinky junctions. After, to extract with a certain resolution pixel region and down sample on each of the 5 direct multispectral images per hand placement. Then, Process with orthogonal line ordinal filter to generate level I palmprint features. Next, Perform round-robin, single-sample matching of palm features by for example the Maximum Hamming distance over multiple translations [21]. Finally, if the palmprint is used in a multibiometric; so we must fuse the palm print by normalizing the match scores to the same range taking into account the product of the individual match scores.

5.2. Hand geometry features

They are based on the area/size of palm, length and width of fingers. Most of the works in the biometric hand are based on the geometric features [36] [39]; [21] used geometric features and implicit finger polynomial invariants. [SAN00] use user-pegs to constrain the rotation and translation of hand.

5.2.1. Contact hand biometric

Most of the systems proposed and/or used are based on research restricted to significantly old patents and commercial products [26]. These systems are made as the user must push his/her hand on the sensor surface, placing his/her dwells correctly with the guidance's peg. From that process it's possible to extract some features like: length, width and height of the fingers, thickness of the hand, aspect ratio of fingers and palm which make possible the building of small template. Some works based on the systems described above was focused on accuracy. [SAN00][29]have proposed an original and better-off geometric features set and have examined the use of multiple templates for a person using the Gaussian Mixture Models to model each focus. [8] suggested the use of the all contour silhouette of the hand in a straight line for matching.
Although, several studies has shown that the peg-based alignment is not very efficient and can be in some cases the source of failure [SAN00] [26]. So, more recent studies has concentrate their works on a more suitable design of a peg-free system [23] [39][12] [2] [18] [42]. Extraction of the hand from the background is the first step of the processing, to after segment the hand in fingers and palm to get finally the geometric features [39] [12] and the contours related to each one of them [18][42].

5.2.2. Contactless hand biometric

A new approach for hand biometric has been used recently in many work, which is the contactless hand biometric. [20] centered on a peg-free hand recognition, based on EIH-inspired method for robustness against noise.

5.3. Hand vein

To provide fast, accurate and robust personal identification, some authors [34] proposed to use the hand vein as feature identification. [17] gives an overview of the hand-vein application. Current products based vein identification permit single person authentication in less than a second.

5.4. Palmprint & hand geometry features

To mitigate each previous technics problems some authors proposed to use the palmprint and the hand geometry features. Some propose to use two different sensors for each part. In [13], the plamprint and the hand shape are extracted from sensor but the fingerprint is extracted from another sensor. Although, the most interesting is to use as for the other bimodal biometric systems, a single sensor. The most appropriate for this situation is to make use of a digital camera to get only one image to process and with a high resolution. This is what proposed [12] and used; they combined the both features kind with fingerprints information, after examining them and using a simple image acquisition setup.

VI. DATA CAPTURE

We can count three techniques for capturing the hand:

- Off-line, palm prints are inked into paper and after scanned by the palm print system. By the past, the researchers used in their works offline palmprint images and get interesting results [DUT01] [44][SHI01].
- On-line, palm prints are scanned directly as in [44]; which presents survey the use of texture to represent low-resolution palmprint images for online personal identification
- Real-time, palm prints are captured and processed in real-time.

6.1. Resolution quality

The both low and high resolutions are based on some features, and it depends on the application where it's used.

6.1.1. Low resolution

PalmPrint features, which are composed of principal lines, wrinkles, minutiae, delta points, etc., and must quote the features and give some techniques and works for the both. However, features like

principal lines and wrinkles, can be extract from a low resolution image with less than 100 dpi [32][47].

6.1.2. High resolution

For features such as minutiae points, ridges, and singular points, a high image resolution is required for a good extraction with at least 400 dpi (dots per inch) [SHI01].

VII. HAND BIOMETRIC IDENTIFICATION/AUTHENTIFICATION

7.1. Detection

First for the recognition, we must extract the hand shape from background [28], as well as motions to obtain hand features [SHI01]. Most of the works used can be based on the hand gesture extraction [31]; because the both are using motion information from extracted hand area in sometimes complex background image for the contactless hand biometric.
Some techniques are used like:

- Background substraction: used mainly for multiple tracking; human (detection in the meeting room), faces and too for the hand detection [22]
- Skin color: Human skin color [10] has been exploited and established to be an efficient feature in many applications from face to hand detection applied in the different color spaces (RGB, HSV, CIE LUV and the CIE LUV). It integrates strong spoof detection and acquisition.

[21]uses the length and the width of the finger.To get the extraction of the hand, when the localization of the hand extremities, the fingertips and the valleys the main problems met are the artifacts and the unsmoothed contour [43].
In some framework, it's both possible to detect a hand and its corresponding shape efficiently and robustly without constraints upon either user or environment. This has long been an area of interest due to its obvious uses in areas such as sign and gesture recognition to name but just two. Boosting is a general method that can be used for improving the accuracy of a given learning algorithm [30].

7.2. Features extraction

7.2.1. Hand geometry

The hand shape integrated acquisition and reduced computational requirements. Several apparatus was issued based on the hand geometry [19] [7][33].

7.2.2. Palmprint

A plamprint pattern is made up of palm lines; principal lines and creases. Line feature matching is known to be strong and present a high accuracy in palmprint verification [32] [47].
Unfortunately, it is difficult to get a high identification rate by means of only principal lines as their similarity amid different people. The texture representation for coarse-level palmprint classification offers a successful technique [44] survey the use of texture to represent low-resolution palmprint images for online personal identification.
We found in [35] that according to the features used for palmprint recognition, we can distinguish within the various palmprint identification techniques three classes: the structural feature based, appearance based and the texture based. For [27], the best palmprint matching approach, in terms of authentication accuracy is those of [35]. This method is based on the comparison of two line-like image areas and the generation one-bit feature code representing at each image location. The success of this method is due to its stability even when the image intensities vary; which were implemented and tested in [27] successfully for the palmprint matching.
When saying Palmprint, we sepakmaily of the major features and the ridges. They reduced need to manipulate hand or pre processing the skin and integrated acquisition. Sometimes, the fingerprints are used because they represent a robust acquisition under adverse conditions.

7.3. Motion

To know more how the articulation of the hand function, studies was done to analyze and synthesize the 3D movement of the hand [4] which was extended to others biometric.

7.4. Translation/rotation

To be used, many problems can be met like the position of the hand in the image, i.e. the way the hand is presented to the sensor mainly in a contactless hand identification situation. [13]employed unconstrained peg-free imaging, based on the efficiencies of the algorithm to achieve illumination, translation and rotation invariant features. Where the acquired images were binarized and in use for feature extraction. The thresholding edge was automatically calculated, by Otsu's approach, once for each acquisition setup.

7.5.Verification

Some works are based on simple classifier as the Mahanlanobis distance [21], mean average distance of contours [8]. [5] applied morphological and Sobel edge features to characterize palmprints and used a neural network classifier for their verification. However, this work has shown the utility of inkless palmprint images acquired from the digital scanner instead of the classical way i.e. the acquisition systems using CCD based digital camera [9].

7.6. Virtual interface

Another main approach in the literature implies the 3D surface reconstructing of the hand. [40]has exploited a range sensor to rebuild the dorsal part hand; they used Local shape index values of the fingers. Sometimes to modalize the hand movement, is used a virtual interface [38]

[14] built an exact hand shape using the splines and hand state recovery could be achieved by minimizing the difference between the silhouettes.

The synthesis fingerprint technique can be applied to synthetic palmprint generation.

7.8. Reconstruction

The estimation of hand pose from visual cues is a key problem in the development of intuitive, non intrusive human computer interface. The solution is to recover a 3d Hand pose from a monocular color sequence; using concepts from stochastic visual segmentation, computer graphics and non linear supervised learning. In [24], made contribution in proposing a automatic system that tracks the hand and estimates its 3D configuration in every frame [ATH01], that does not impose any restrictions on the hand shape, does not require manual initialization, and can easily recover from estimation error. It is possible to approach this problem using a combination of vision and statistical learning tools.

VIII. EXISTING METHOD

Different hand biometric (measurement) techniques need differentresources from operating systems to enable biometricauthentication on the technical basis of measuring a biologicalcharacteristic. Next table gives a tabular overview of different features used.

Six features are considered:

Systems	No. of people	No. of sample per person	Pegs	N of template (s)	Feature (s)	Similarity	Performance	Resolution
Zhang [46]	500	6	No	2	Joint palmprint and palmvein verification	Dynamic weight sum	EER 0.0212% and 0.0158%	352 * 288
Ladoux [15]	24	N/N	N/N	N/N	Palm Vein	SIFT	EER 0%.	232x280
Heenaye [6]	200	N/N	N/D	N/D	Dorsal hand vein pattern,	Cholesky decomposition and Lanczos algorithm	FAR 0%, FRR 0%	320×240

Shahin [SAH07]	50	10	N/D	2	Dorsal hand vein pattern	maximum correlation percentage	FAR of 0.02% and FRR of 3.00 %	N/D
Uhl [37]	25	25	No	N/D	Eigen fingers and minutiae Features	Parallel Versus Serial Classifier Combination	97.6% RR at 0.1% FAR)	500 dpi
Zhang [ZHA09]	120	48	No	4	FINGER-KNUCKLE-PRINT	angular distance	FRR 0.01% anf FAR 96.83%	N/D
Oden [ODE03]	27	10	No	270	Geometric features and implicit polynomials invariants of fingers	Mahalanobis distance	N/D	N/D

IX. CONCLUSION

In this paper, we considered a state of art of the hand biometric. The hand can be fusion with other biometrics as face fingerprint and many others [25]. The fact that a disgruntled employee or customer or a person with criminal intentions of entitlement of an active employee in her property and thus brings gives unauthorized access, is another security risk that exclude the biometric hand scanners effectively. One of the most important indirect problems of the hand biometric, is the hand geometry imitation. If the person has arthritis, long fingernails, is wearing hand cream or has circulation problems then this will not produce a good reading. The experimental results provide the basis for the furtherdevelopment of a fully automated hand-based security systemwith high performance in terms of effectiveness, accuracy, robustness,and efficiency.Individual mobility doesn't have a price; hence, Hand Biometric Technologies have to be implemented whenever and wherever possible.

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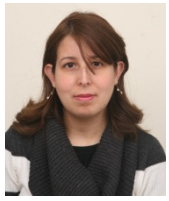

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