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Palm Biometrics: Testimony of Security

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Abstract

Now a days, whenever we think of developing a system or software, the first thing that comes in one's mind is Security. We always think whether the given system is secure enough to use or not? This question arises because Security is no more secure word in today's world because of unlawful persons. So, to provide assertion there comes an epoch i.e. BIOMETRICS. This field has gained wide popularity all over the universe, as it recognizes our Biological or Physiological characteristics and assures whether the person is approved or not to use the system. Biometrics is an authentication tool and its level of security is much higher as compared to passwords or PIN. This paper presents a Biometric System based on palm geometry oriented to contact based but peg free scenario. This paper has mainly four innovative aspects: A brief description about Biometrics. Secondly, comparisons between various technologies of Biometrics like Face, Hand, Iris and Finger based on different parameters. Thirdly, it explains the basic methodology used in Biometric Systems. Last but not the least recent work has been discussed in brief.

Keywords: Cataloguing, EER-Equal, FRR-False Reject Rate, FAR-False Accept Rate, PIN- Personal Identity Number.

Introduction

A. Glimpse of History

The field of Biometrics came in progress in the year 1880's. On the 1890, a French anthropologist in Paris, Alphonse Bertillon, decided to solve the problem of recognizing thief's or criminals as they created the so much offense. The name given to that system was Bertillonage. There was no system at that time which could help to recognize the thief's or any unauthorized person and there was not any record keeping system so, that unauthorized person could be traced. This was the actual reason for development of Biometrics System. Alphonse Bertillon was an anthropologist, an anthropologist is one who has knowledge of anthropology i.e. study of humankind that draws and build knowledge from the humanities and natural science. So, he took parameters as body weight, body description, eye color, complexion and attached photograph for identifying an individual's identity and detect whether the person is authorized or unauthorized. This system did not gain any wide popularity because the parameters which were taken were not secure enough and it could be possessed by more than an individual like person's height or weight, it's not unique to an individual. So, this system began to fall. Later, in 1892, a new Biometric system was developed by Sir. Francis Galton. This system was different from Bertillonage system as its parameters used were different i.e. fingerprints. The

Fingerprint is a parameter which is unique in everyone and is still being used for verification. So, this system after usage gained wide popularity unlike Bertillonage.

B. Basics of Biometrics

Biometrics is a branch of science that deals with bio i.e. characteristics or traits of human beings and metrics i.e. measurement. So, when we spell this word all together, i.e. Biometrics it is a technology where we measure human beings traits that may be physiological or behavioral. Based on these traits only we can verify that whether the person using the system is endorsed or not. Earlier, tokens or passwords were used as a medium to provide security as in that case user had to remember his PIN or password so, that he/she could use the particular system, but there were certain difficulties regarding memorizing the passwords or PIN. A user could forget that and in that case he can never use that system as he is marked as an unauthorized candidate to use a particular system not only this, sometimes user's were allotted ID cards which can be misplaced and it would be an advantage for an unauthorized person to use the system and confidential data could be stolen or lost. So, this could cause interruption and effects security as well. So, to prevent all this from happening a new technology was developed. So, that

all the problems could be solved and there will be no issue to memorize the keywords or loosing ID cards as well. Biometrics is a technology which helps us to do so, here a person just has to place his hand on the scanner, hand will be scanned and features will be extracted , the first time when a person is enrolling himself or using the scanner so, that his features are extracted and saved in the database.
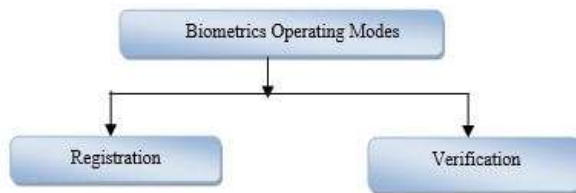

Fig 1 Biometrics

Figure2 Operating Modes of Biometric Systems

- Registration

Firstly, a person has to register himself whenever he/she is using the Biometric system for the first time. This process is called cataloguing. In this process of registration there is one to one matching, i.e. after registration a person will be given a PIN or ID card no. which is unique among all the users using this system, if he/she has that in the future then only that person can use the system. Also, here different images of a person are captured; features are extracted and stored as a template in database for further verification. So, in this process basically a person's identity is registered so that after registration, verification of an individual can be done by comparing the questioned image and the image in database.

Figure3 Registration

- Recognition

The second phase is of Recognition, in this process, there is one to many kind of relation because a person has to be verified with the traits he possesses. The traits are measured and stored in database in registration phase only and here, in this phase image processing and feature extraction are of main concern. In this phase, the traits are matched with the database if the parameters match, the person is authorized otherwise not. Verification is totally based on characteristics the person possesses.

Fig 4 Recognition

C. Biometric Traits
Biometrics Traits can be classified as-

- Physical Attributes

It is based on a measure of geometry of body part like fingerprints, eye or iris patterns, facial patterns, hand measurement, ear shape, and Thump print, Vein patterns or DNA. Here, we can consider different parameters of physical attributes and check with the database, whether the person is same as he claims to be.

- Behavioral Attributes

It is based on the way a person behaves or gestures and postures are taken into consideration. These attributes of humans can also be considered as they too are exclusive like pressing of keystrokes, it recognizes the way a person presses the keystrokes, signature attributes are recognized the way person

signs, and everyone has its own style of writing on paper as well. Similarly, gait traits are based on the way a person walks, his gestures and postures are considered and then matched with the database.

- Physical and Behavioral Attributes

It is a combination of both attributes we studied above, i.e. Physical and Behavioral; it recognizes the pattern and measures the geometry of lips at the same time like voice the way a person speaks. The movement of the lips is recorded as the way a person speaks or pronounces a word and voice patterns are recorded and checked with the database.
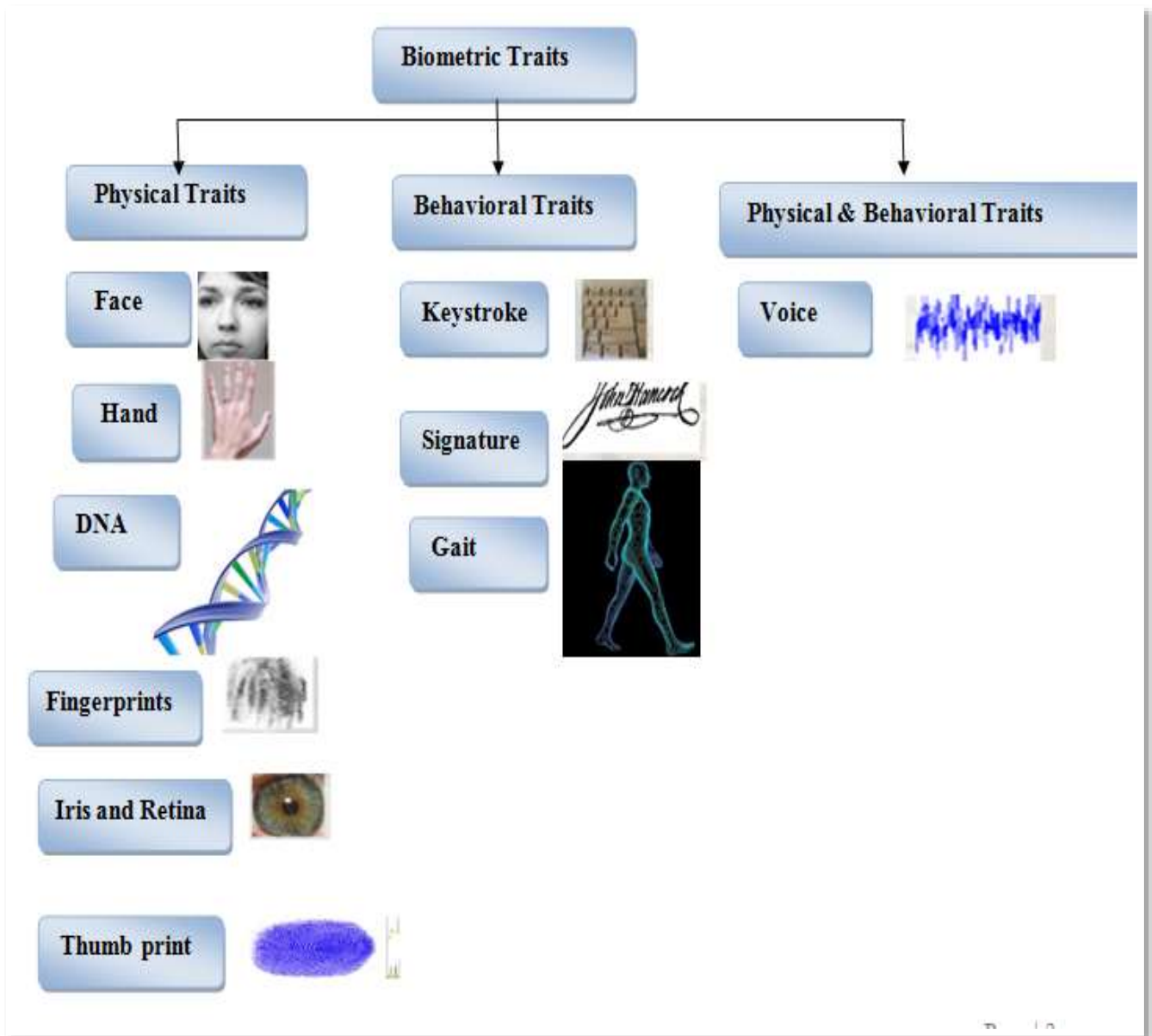

Fig 5 Biometric Characteristics

Biometric technologies

A. *Comparison between Various Biometric Technologies*

Table 1 Comparison of Biometric Technologies

Characteristics	Fingerprint	Iris	Hand	Face
How it works?	Captures and compares fingertips.	Captures and compares iris Patterns	Capture and compares different parameters.	Capture and compares different landmarks.
Accuracy	Medium	High	High	Low
Cost of device	Low	High	Moderate	High
Level of Security	Low	Medium	High	Low
FRR	.2-36%	1.9-6%	0-5%	3.3-70%
FAR	0-8%	<1%	0-2.1%	.3-5%
Stability	Low	Medium	Medium	Low
Transaction Time(around)	19 sec	12 sec	10 sec	10sec
Enrolment Time(around)	3sec	2sec	1sec	3sec
Scope of Error	Dust, age, Cut	Effect of Light	Age, Injury, Dryness, Dust.	Lightning, Age, Hair,

After Comparison, we can conclude that Hand Biometric System is best among all of the Biometric Technologies and to work on. We have chosen the inner surface of the hand from wrist to the base of the fingers which is called Palm. It has been proved that Palm biometric systems are more accurate rather than entire hand geometry. So, this is the reason why i have chosen this topic on Palm Biometrics Also, the tag line is given i.e. TESTIMONY OF SECURITY. Here, Testimony means something that serves as evidence and Security means a state which is free from threat or danger. When we combine this tag line and read it based on Palm Biometrics, it means that Palm Biometrics is an inimitable tool which is an evidence that will provide security. So, this tag line clearly defines the purpose of Palm Biometrics.

B. *Motivation*
After analyzing comparison between various biometric technologies, I have come to a conclusion that the Hand biometric system is the best one to work on and not only this there are many other reasons mentioned below-

- Exclusiveness

Hand geometry has a feature of exclusiveness i.e. its unique, no two persons in the universe can possess the same characteristics.

- Cannot be mutual

It cannot be shared; it is not possible that anyone can share his/her characteristics with anyone .It is not possible and not valid.

- Cannot be clichéd

It cannot be copied .It is not probable to copy the characteristics of one person and the other person can use.

- Cannot be stolen

No one can steal biometric characteristics of an individual as it's unique.

- Cannot be misplaced

Biometric features can be lost only in case of accidents not otherwise. We can never give this statement that "I have misplaced my hand" yes, it is possible with passwords or ID cards not with Biometrics.

- Cannot be fictitious

These features cannot be invented it's gifted by God. So, if we try doing still, it's not possible to create a thing which can replace human hand.

- No undue requirements needed

It does not require ant heavy setup or any extraordinary sensors. It just requires a simple sensor for sensing an image, a computer to store information and software which performs comparison and analyses the human characteristics.

Biometric methodology

There are basically five modules in biometric methodology.

- **Image Acquisition**

This is the first module in the methodology of Biometrics. In this module images are collected or captured using a flat scanner or CCD camera. This is also called initialization stage where

we need to collect all the data and here the data will be in the form of images which can be in any format. So, the name given to this phase is Image Acquisition. Here, more than one picture per person is collected. So, that later on best picture among them can be chosen and sent to other modules.

- **Image processing**

This is the second phase, which is called Image or Signal processing. It is defined as means of translation between human vision and digital device. There is lot of difference in human vision and a digital device. Human vision does not perceive the same result as digital device like additional noise, bandwidth. So, in that case reading, analyzing and modifying an image is must. This process is called Image Processing. While modifying an image certain operations can be used that includes:

o Conversion of RGB image to gray sacle
o Thresholding
o Denoising
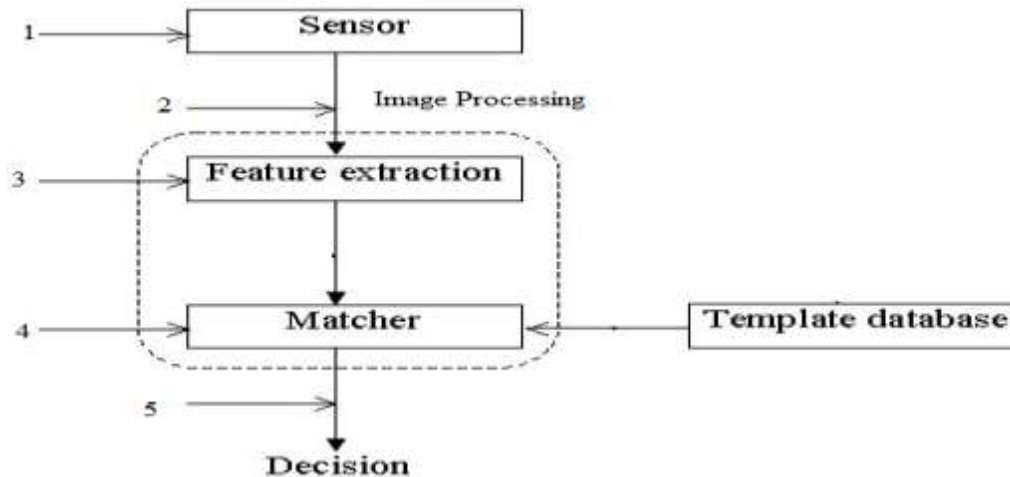o Edge Detection
o Morphological Operations

Figure 6 Biometric Methodology

- **Feature Extraction**

This is the third phase in which we have to choose features of palm. Feature extraction can be two types-

A. Line Based

In line based feature extraction different edge detection methods can be used like principal lines, curves, ridges, wrinkles etc. But, there is a possibility that lines can be same for more than 1 person.

B. Texture Based

To overcome the limitation of line based approach, texture based approach is used and here,Principal component analysis (PCA) or Linear discriminant

analysis (LDA) can be in use directly on the palm-print image and transformations like Fourier , discrete or wavelets can be used. Also classifiers like neural networks and Euclidean distance can be used.

- **Verification**

In this phase, after data has been stored into database. Now, the person can use the biometric system. As soon as he keeps his palm on the sensor, it will compare the data with the already stored database of the selected features and performs verification. For verification, algorithm has to be implemented so that it can perform pattern matching and that algorithm is

inbuilt in the sensor so, that it can perform pattern matching with the already stored image.

- **Decision**

This is the last phase in which a user after he/she is verified if he/she is the same person as they claim i.e. Decision will always be either positive or negative. If decision is positive that means the user is authorized to use the system and if the decision is negative, that means the user is unauthorized to use the system.

Related work

Amit Taneja et al.[1] purposed a Biometric System, and explains its importance . It takes the input as a colored photograph; it may have any extension like jpg, gif, png or bmp. Then image processing is done to remove additional noise. After that, it extracts features of an individual which are further used for verification of questioned image with actual images. It tries to solve problem related with pegs as they deform the shape of hand while using the system and affects accuracy. The proposed system, allows the user to keep his hand on the system comfortably without any support. It considers total 10 features. For pattern recognition Neural networks has been used and FAR around 0.18% was obtained, which makes the system 89% secure.

J. Jobin et al.[2] presented a Biometric Identification System based on hand geometry and its goal was to increase both the accuracy and the interpretability of that system. Here, the absolute distance function was used to calculate the features of hand like the length and width of the fingers, diameter and perimeter of the palm, area of Distal Phalanx. Here, 50 test images were used and after implementation, it has been observed that 48 out 50 users were correctly identified, which makes 96% of accuracy.

M.P Dale et al.[3] proposed a multimodal system in which complete hand image was considered to find hand geometry and palm texture features. Here, the problem of undergoing various sensors for identification was solved. The proposed system helped to extract features easily using a single sensor and hand geometry features were calculated like distance between various boundary points and palm texture. First, the values were calculated separately for geometry and palm and overall result was calculated by fusion of both the results calculated before. The genuine acceptance rate has been calculated at different rotations of hand and it comes out to be 99.5% and Equal Error Rate (EER) achieved is 1.11.

D.B. Ojha et al.[4] discussed the issue in personal base authentication system due to addition of

errors during transmission. The purposed work here has been done to improve Biometric Templates Security based on concept of encryption with a secret key. Here, a Biometric based authentication system was developed which is based on braid groups for security and fuzzy error correction code which determines the error that is included during transmission between user to the database server. This system projected five algorithms, i.e. setup, encryption, decryption, enrollment, verification. The result is based on detection of errors.

Rachita Misra et al.[5] presented a Biometric System based on texture properties of palm images for verification purpose and all the characteristics of palm are considered here, like ridges, curves, crease, principal lines, wrinkles etc. The technique used here, was very simple and feature vectors were small which makes the implementation much simpler. Here, the image were divided into different regions and then analyzed. The results were then calculated as the minimum distance between the known and training samples and different iterations were performed at training classes. The palm print identification system verifies the input image with test samples. In single iteration, the result was 70-90%, whereas in the second iteration, result was found to be 100%.

Smita Kulkarni[6] purposed a multimodal biometric system and acc. to this paper, multimodal biometric systems are better than uni modal biometric systems. Here, fusion of fingerprint and face was done. It explained score level fusion; which is based on scores and has sufficient information to categorize a person as genuine or an imposter. Before fusion, normalization was done using min-max normalization scheme. It matches the matching score to an interval of [0,1] and retains the original distribution. The results were calculated for right and left fingerprints separately. Fusion at the end was done using sum rule and the value of threshold was calculated based on FAR. Value of FAR has to be smaller as possible and value of GAR should be greater than FAR.

Vipin Kumar Jain et al.[7] proposed a new technique to extract principal lines of palm using a standard filter like Average, disk, Gaussian, Laplacian, log, motion, Prewitt, Sobel, unsharp. It also solves problem of rotation and translation of palm, which is normally observed when a photograph is captured using a camera. So, instead of using a digital camera, here flat scanner has been proposed and features were extracted by placing a square wooden strip, so that there could be no rotation of hand and a fix point is set up. For pattern recognition, neural networks has been used which will help to select data, create and train a

network, and evaluate its performance using mean square error and confusion matrices. The result here has been calculated as, percentage error is 0-2.3 and mean square error is between 0.30 and 0.001.

Sandeep Kaur et al.[8] presented techniques used in Palm Print and hand gesture recognition. Acc. to this paper, in palm print recognition, two techniques were used: Feature and Appearance based approach. In feature based approach, features like hand geometry, palm width, height, principal lines, wrinkles, ridges, datum points etc. were considered and Appearance based approach, observes the entire palm. Hand gesture recognition helps users to interact with machines; it will help users to share their thoughts, views with machines just with the help of gestures. Here also two techniques were used: Appearance and Model based approach. Appearance based approach considers only the fingertips of the hand and in Model based approach; a histogram was used for calculating the probability of skin color observation Sawah. Hu used the Gaussian distribution for marking background pixels, then, pixels from new image were subtracted to get gesture image.

Renu Bhatia[9] highlighted the importance of Biometrics in today's world. Here, general Biometric System has been explained i.e. the way it works and many characteristics related to Biometrics are explained. It also compares various Biometric Technologies like Fingerprints, Hand, Iris, Retina, Face, Signature, voice and also it gives advantages and disadvantages of each trait after justification. It described steps, algorithm, techniques and functions of Face Recognition. At last it concluded that face recognition technology is most reliable, inexpensive, and most accurate at the same time it is very challenging among all the technologies discussed.

Rupinder Saini, Narinder Rana [10] compared various Biometric Systems with advantages and disadvantages. A brief description of various popular Biometric Systems like Face, Iris, Voice, Finger Print, Finger Vein and Lips is given based on parameters like accuracy, Security, Cost, Size of Template and Long term stability. It concluded that face recognition is a more challenging parameter in terms of accuracy, efficiency, speed and cost.

Conclusion

Biometrics is an important technology to proceed nowadays, the main reason being for this is Security. Biometrics has proven itself to be the most consistent and endorsement toll which works on human traits to check his identity. It simply registers the user features and then verifies that particular person as he claims to be. No doubt this is not a new

technology; its origin has already been discussed, but this field is still being used till date like access control, attendance, banks, forensics etc. It's just because its level of security and accuracy are high as compared to username or password or any kind of tokens like a PIN. In this survey mainly work is done on basics of Biometrics like from where it was originated, its principle and standards are clearly explained. Then, Comparison of biometric technologies gives a clear vision which can help an individual to understand the various parameters of Biometric Technologies. Methodology in Biometrics is explained with a diagram, one can clearly understand how to proceed during implementation. Last but not the least recent work gives a brief description about the work that has been carried and also it discusses the latest platform, techniques and transformation that are in trend nowadays.

Future work

So, after reading this survey, one can get an inspiration to move on to this field and after analyzing this paper one can choose the parameters like hand, face, iris, finger etc of his/her interest. Also, one can choose the parameters based on accuracy level and a person can work on his region of interest. One can also use the upcoming techniques and transformations to improve the already calculated results. Work can be done to improve contact less platform which is in popularity nowadays. Not only this, fusion of biometrics is also a proposal to work on.

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