



Volume XXIII 2020

ISSUE no.1

MBNA Publishing House Constanta 2020



Scientific Bulletin of Naval Academy

SBNA PAPER • OPEN ACCESS

Biometric security: Recognition according to the pattern of palm veins

To cite this article: Manoliu Mitica-Valentin, Travediu Ana-Maria and Racuciu Ciprian, Scientific Bulletin of Naval Academy, Vol. XXIII 2020, pg.257-262.

Available online at www.anmb.ro

ISSN: 2392-8956; ISSN-L: 1454-864X

doi: 10.21279/1454-864X-20-I1-036

SBNA© 2020. This work is licensed under the CC BY-NC-SA 4.0 License

Biometric security: Recognition according to the pattern of palm veins

PhD Student: Manoliu Mitica-Valentin

Military Technical Academy "Ferdinand I"

manoliu_mit@yahoo.com

Student: Travediu Ana-Maria

The Faculty of Electronics, Telecommunications and Information Technology

ana.travediu@yahoo.com

Coordinator PhD: Racuciu Ciprian

Military Technical Academy "Ferdinand I"

ciprian.racuciu@gmail.com

ABSTRACT Palm vein recognition is a promising new biometric method, which has additional potential in the forensic field. This process is performed using light using NIR(Near-infrared) LEDs and the camera that captures the acquisition of veins. The obtained images have noise with variations of rotation and translation. Therefore, the input image made by the camera must be pre-processed using characteristic processes. A set of features is extracted based on images taken from infrared light cameras and processed in order to make authentication possible. This whole process can be accomplished by several methods. Thus, the application can be used to improve the security of military ships in restricted areas, but not only.

Introduction: Biometrics is the technical term for body measurements and calculations. It refers to metrics related to human characteristics. Biometrics authentication is used in computer science as a form of identification and access control. It is also used to identify individuals in groups that are under surveillance.

At the beginning we introduce some biometrical attributes, especially the fingerprints and palmveins ,and we discuss their advantages and disadvantages when used in Biometric Security Systems. On example of the well understood of palm veins technology we try to estimate the upper limit for the amount of available information on a fingerprint and finger vein. Aldoght a certain diagram describes the architecture of optical penetration wave lengths into skin subvising Biometric Security System focused on NIR or FIR vein absorbing . A qualified draft of the design is shown in this chapter. Finally the last chapter outlines the transformation of a biometric information key from fingerprint and finger vein the comparison of this key.

Biometric identifiers are the distinctive, measurable characteristics used to label and describe individuals. Biometric identifiers are often categorized as physiological versus behavioral characteristics. Physiological characteristics are related to the shape of the body.

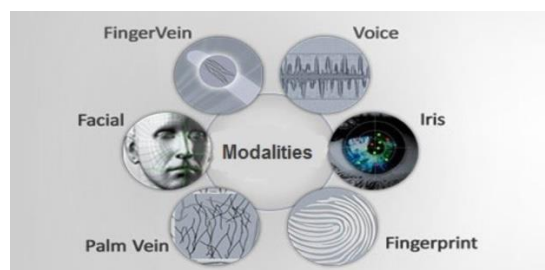


Fig.1: Various Biometric Systems.

In Fig.1 examples include, but are not limited to **fingerprint, palm veins, facerecognition, DNA, palmprint, handgeometry, irisrecognition, retina and odour/scent.**

A short Brief into Biometrics and data protection :

The "United Nations Resolution" of 14 December 1990, which sets out guidelines for the regulation of computerized personal data files, does not have any binding force. On a more global basis, legal deliberations thus rely to a vast extent on provisions relating to personal data in the broad sense. But such provisions sometimes prove to be poorly adapted to biometrics. On the contrary, the new E.U. regulation replaces the existing national laws as of May 2018.

The General Data Protection Regulation is directly applicable in all 27 Member States of the European Union and the U.K. as of May 2018. [7]

And so, biometric data are clearly defined and protected.

In a nutshell, it establishes:

1. A harmonized framework within the E.U.,
2. The right to be forgotten,
3. "Clear" and "affirmative" consent,
4. Severe penalties for failure to comply with these rules.

SELECTING A BIOMETRIC TECHNOLOGY: Biometric technology is one area that no segment of the IT industry can afford to ignore. Biometrics provide security benefits across the spectrum, from IT vendors to end users, and from security system developers to security system users. All these industry sectors must evaluate the costs and benefits of implementing such security measures. Different technologies may be appropriate for different applications, depending on perceived user profiles, the need to interface with other systems or databases, environmental conditions, and a host of other application-specific parameters (see table1).[8]

Characteristic	Fingerprints	Hand geometry	Retina	Iris	Face	Signature	Voice
Ease of Use	High	High	Low	Medium	Medium	High	High
Error incidence	Dryness, dirt, age	Hand injury, age	Glasses	Poor lighting	Lighting, age, glasses, hair	Changing signatures	Noise, colds, weather
Accuracy	High	High	Very high	Very high	High	High	High
Cost	*	*	*	*	*	*	*
User acceptance	Medium	Medium	Medium	Medium	Medium	Very high	High
Required security level	High	Medium	High	Very high	Medium	Medium	Medium
Long-term stability	High	Medium	High	High	Medium	Medium	Medium

* The large number of factors involved makes a simple cost comparison impractical.

Table 1 Comparision of biometrics

Problems with current security systems... • Based on Passwords, or ID/Swipe cards • Can be Lost. • Can be forgotten. • Worse! Can be stolen and used by a thief/intruder to access your data, bank accounts, etc !

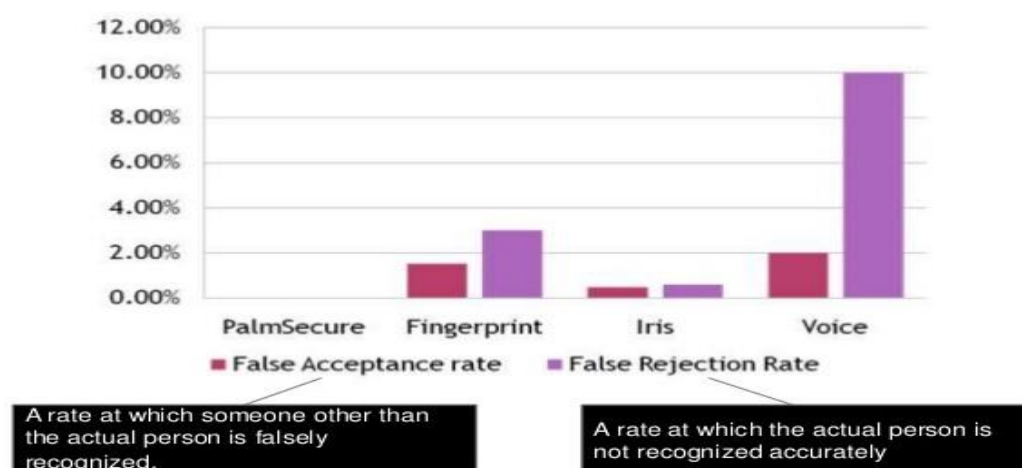


Fig.2 FAR (False AcceptanceRate)

Fig.2 assimilates two items of biometric data : "False rejection" or "false acceptance" are symptoms that occur with all techniques used in biometrics

ACCURACY TECHNOLOGY FALSE ACCEPTANCE RATE FALSE REJECTON RATE :

PALM VEIN0.00008% 0.01%; **FINGERPRINT**1-2% 3%; **IRIS** 0.0001% -0.94% 0.99%0.2% ;**VOICE**2% 10%17

Is biometrics reliable?

Biometric authentication relies on statistical algorithms. It, therefore, cannot be 100 %-reliable when used alone.

"false rejections" or "false acceptances"

What's the story here?

- In one case, the machine fails to recognize an item of biometric data that does, however, correspond to the person.
- In the reverse case, it assimilates two items of biometric data that are not from the same person.

"False rejection" or "false acceptance" are symptoms that occur with all techniques used in biometrics. [5]

Palm vein technology is one of upcoming technology. It is the world's first contact less personal identification system that uses the vein patterns in human palms to confirm a person's identity, highly secure and accurate. Integrated optical system in the palm vein sensor uses this phenomenon to generate an image of the palm vein pattern. Generated image is digitized, encrypted and finally stored as a registered template in the data base.

The problems with finger print systems: Finger prints can be easily copied. Wrong result if the finger is dirty. False positives. If the software is not sufficiently sophisticated concerns over hygiene.

The problems with facial biometrics : With age, facial recognition deteriorates. Changes in appearance with the use of cosmetics, earrings, hair, etc. can give wrong readings too. It's estimated there's a 5% drop in accuracy per year due to aging.

The problems with iris scanning are: The accuracy of scanners can be affected by changes in lighting. Iris scanner art significantly more expensive than some other forms of biometrics

The most important advantages of biometrics are:

1. Biometric features cannot be lost or forgotten
2. Biometric features are difficult to copy, share and distribute
3. They require that the authenticated person be present at the time and at the authentication point.

Palm vein-based biometric authentication system aims to recognise individuals from their unique palm vein structure which is next to impossible to duplicate owing to the fact that palm veins are present in the subsurface of the skin and not apparent under visual light

Technology: According to BIOGUARD (innovative biometric solutions) palm vein technology works by identifying the subcutaneous (beneath the skin) vein patterns in an individual's hand. When a user's hand is held over a scanner, a near-infrared light maps the location of the veins.

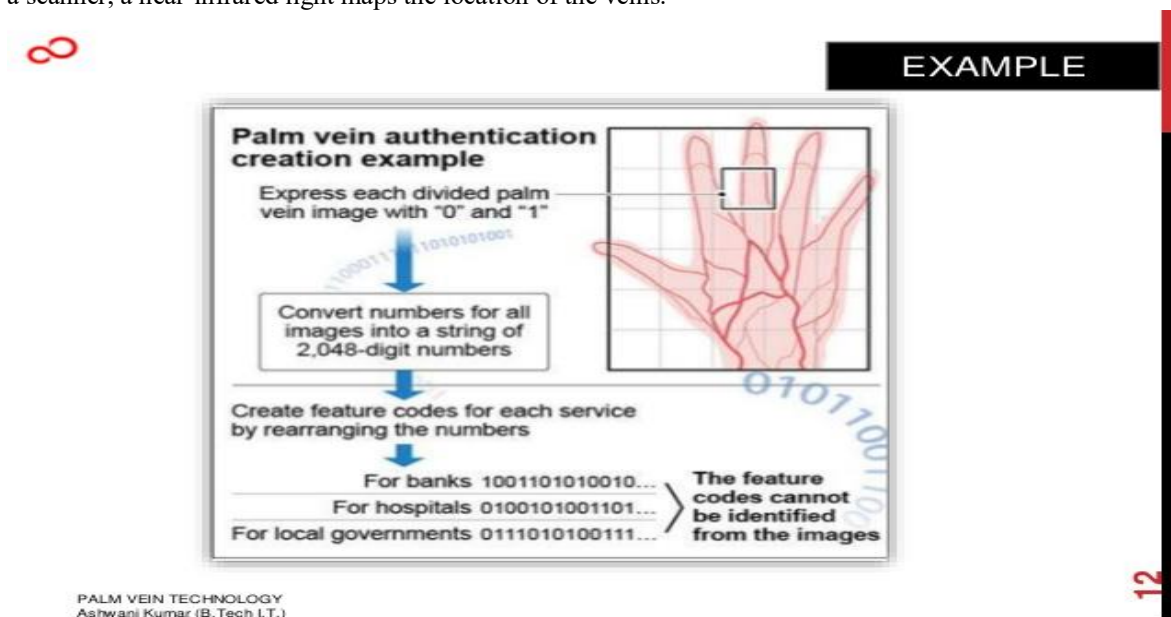


Fig.3 Palm Vein Technology

In Fig.3 we have an example of palm vein authentication : The red blood cells (hemoglobin) present in the veins absorb the rays and show up on the map as black lines, whereas the remaining hand structure shows up as white. This vein pattern is then verified against a preregistered pattern to authenticate the individual. As veins are internal in the body and have a wealth of differentiating features, attempts to forge an identity are extremely difficult, thereby enabling a high level of security. Additionally, the sensor of the palm vein device can only recognize the pattern if the hemoglobin is actively flowing within the individual's veins.[10]

Image capture system : For the purpose of the use of proper light source for imaging the penetration of different wave lengths into the skin is studied. Fig.4 shows the depth of penetration at different wave lengths, continued by Fig.5 that shows the results of 3 methods used for recognition.

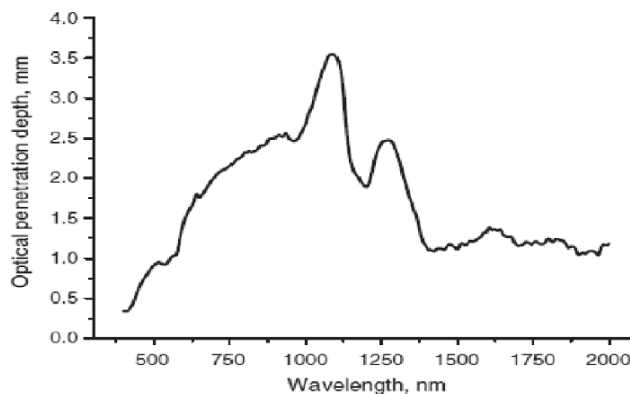


Fig.4 Optical penetration depth

Methods	% accuracy
PCA	85.48
2D wavelet transform	39
Template matching	93.54

Fig.5 Results of 3 methods used for recognition

There are two types of infrared imaging techniques namely, near infrared (NIR) and far infrared (FIR). NIR is less sensitive to temperature and humidity hence proves to be a better source of illumination. Wang and Leedham(2006) have presented the advantages and disadvantages of both the techniques.[1]

Implementation of the PCS algorithm:

Principle component analysis: Kumari et al. (2011) have defined a good pattern matching algorithm. The PCA analysis of CASIA database images have been carried out. PCA algorithm: [6]

1. Read all ROIs and store its pixel values into array forming a matrix having columns equal to total number of ROIs read (Matrix A).

2. Calculate mean of this matrix (mean of each row).

3. Find deviation matrix from its mean matrix.

4 Calculate eigen vectors of this deviation matrix (Ev is Eigen vector).

5 Project each image into Eigen face of deviation matrix.

6 Read image to be matched and convert into grey-scale.

7 Extract ROI from image to be matched and enhance it (T).

8 Form a vector with number of rows equal to size of test ROI (Z).

9 Calculate difference matrix from mean matrix.

10 Find projected test image.

11 Find minimum difference with projected test image.

12 Image with minimum difference will represent the test image.

$$B(i,j) = A(i,j) - M_i$$

$$E = B \times E_v$$

$$P_j = E' \times A_j'$$

$$D = Z - M_i$$

$$Q = E' \times D$$

Principles : This paper presents a review on the palm vein authentication device that uses blood vessel patterns as a personal identifying factor. The vein information is hard to duplicate since veins are internal to the human body. The palm vein authentication technology offers a high level of accuracy.



Fig.6 Palm Vein Authentication Technology

In Fig.6 we can see that Palm vein authentication uses the vascular patterns of an individual's palm as personal identification data: Name; Home address; Business address; Car registration; Phone number ;other [3]

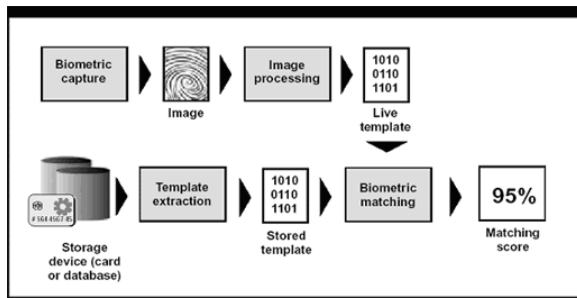


Fig.7 Biometric pattern



Fig.8 Finger Vein Recognition

In Fig.7 and Fig.8 we have compared a fingerprint, and a finger veins technology that has a broader and more complicated vascular pattern and thus contains a wealth of differentiating features for personal identification. The importance of biometrics in the current field of Security has been depicted in this work. [2]

The grey-scale image is binarised to separate the palm region from the background by regular thresholding. The threshold is deduced after observing all the captured images. The web points are observed to follow a specific pattern as follows.

Compared to the other biometric systems, the user's veins are located inside the human body. Therefore, the recognition system will capture images of the vein patterns inside of users' fingers by applying light transmission to each finger. For more details, the method works by passing near-infrared light through fingers, this way a camera can record vein patterns

One of the recent biometric technologies invented is the vein recognition system. Veins are blood vessels that carry blood to the heart. Each person's veins have unique physical and behavioral traits. Taking advantage of this, biometrics uses unique characteristics of the veins as a method to identify the user. Vein recognition systems mainly focus on the veins in the users hands. Each finger on human hand has veins which connect directly with the heart and it has its own physical traits[9]

The New face of BIOMETRIC is more reliable and accurate ,ultra secure and time consuming,with wide application range,and not to mention : Much before than the existing biometric sysytem!

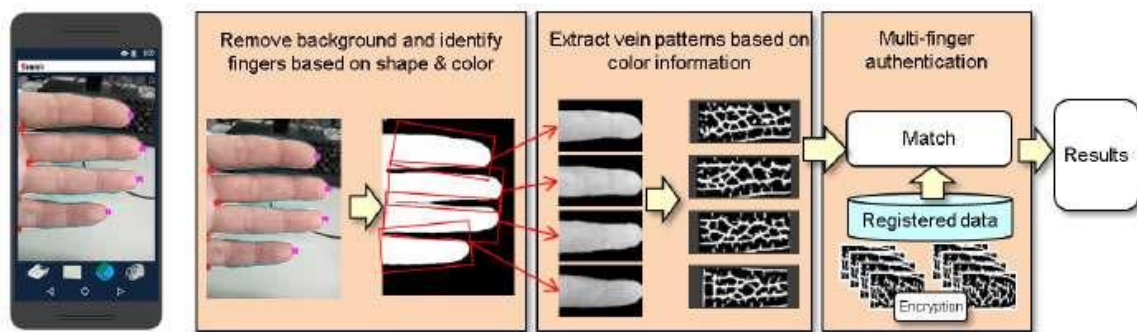
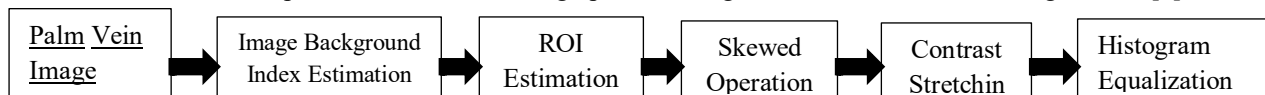


Fig.9 Multi-Finger authentication

In Fig.9 we have the potential limitation of supporting only one of 1:1 and 1:N scanning in either of the two modes, has led to development of multi-modal fingerprint and finger vein simultaneous scanning devices.[4]



We have also outlined opinions about the utility of biometric authentication systems, comparison between different techniques and their advantages and disadvantages in this paper. Several banks in Japan have used the palm vein authentication technology for customer identification since July 2004. In addition, Fujitsu has integrated the technology into the access control of electronic door lock systems. Fujitsu plans to further expand applications for this technology by downsizing the sensor and improving the verification speed.

Conclusions : .

There are many advantages of vein recognition system in real time applications and in security systems. Some of them are firstly; this system gives a hygienic behavior as the device used to capture the images is contactless. It gives more accurate result in terms of FAR and FRR up to 0.00008%.

Biometric Recognition for Authentication This technology can be helpful in the biometric recognition authentication purposes. One can unlock their personal information or access confidential data with the help of unique vein structure security system.

As biometric technology matures, there will be an increasing interaction among the market, technology, and the applications. This interaction will be influenced by the added value of the technology, user acceptance, and the credibility of the service provider. It is too early to predict where and how biometric technology would evolve and get embedded in which applications. But it is certain that biometric-based recognition will have a profound influence on the way we conduct our daily business.

Biometric Attendance This system can also be used for biometric attendance purpose in colleges, schools, institutions and organizations as the system is very accurate. This will also increase the security and productivity of the institution. When the enrolled person put their hand in front of near infrared camera, it captures the image and matched with the image that is pre-registered in the data base.

ATM Using this service of vein recognition, the customer does not need any type of smart card and pass book for their money transaction. Chances of frauds is minimized as non-registered user cannot withdraw the money and cannot access others account.

References:

- [1] https://www.researchgate.net/figure/FIR-images-of-the-back-of-the-hands-in-an-outdoor-environment-where-veins-are-not_fig3_3481329
- [2] <https://www.bayometric.com/fingerprint-vs-finger-vein-biometric-authentication/>
- [3] Ding, Y.H., Zhuang, D.Y., Wang, K.J. A Study of Hand Vein Recognition Method, Proceedings of the IEEE International Conference on Mechatronics & Automation Niagara Falls, Canada, 2107-2110.
- [4] Wang, Y.D., Fan, Y., Liao, W.P., Li, K.F., Shark, L.K., Varley, M.R. Hand Vein Recognition Based on Multiple Keypoints Sets, IEEE international conference, ISBN: 978-1-4673-0397-2, 367-371.
- [5] <https://www.thalesgroup.com/en/markets/digital-identity-and-security/government/inspired/biometrics>
- [6] Jia, X., Cui, J., Xue, D. and Pan, F. (2012) 'A adaptive dorsal hand vein recognition algorithm based on optimized HMM', Journal of Computational Information Systems, Vol. 8, No. 1, pp.313–322.
- [7] <https://www.thalesgroup.com/en/markets/digital-identity-and-security/government/inspired/biometrics>
- [8] <https://cedar.buffalo.edu/~govind/CSE717/papers/PracticalGuide.pdf>
- [9] Nguyen, D.T., Yoon, H.S., Danh, T.Y., Pham, Park, K.R. 2017. Spoof Detection for Finger-Vein Recognition System Using NIR Camera, 2261(17),1-34.
- [10] Mohamed Shahin, Ahmed Badawi, and Mohamed Kamel, "Biometric Authentication Using Fast Correlation of Near Infrared Hand Vein Patterns", International Journal of Biological and Medical Sciences, vol 2, No.1, winter 2007, pp. 141-148.