A REVIEW ON BIOMETRIC SYSTEMS

Zohreh Mousavinasab*

Shabnam Azari*

Abstract: *Biometric has taken from the Greek word "bios" meaning life, and "Metrikos" managing measurement and has introduced an Environmental Meter. A biometric system is essentially a pattern recognition system which recognizes a person based on special features, specific physiological or behavior vectors. The obtained feature vectors are stored in the database. Generally, a biometric system based on physiological characteristics has a high reliability. In this paper, we try to bring some of biometric identification techniques alongside their advantages and disadvantages.*

*Department of Computer Engineering, Omidiyeh Branch, Islamic Azad University, Omidiyeh, Iran

1- INTRODUCTION

Since beginning, human beings are needed to distinguish friend from foe for survival and identification has been always critical for him; so these days have been tried to mechanization the identification or authentication systems. "These developments have been based on the needs of society and the world" [1]. A need for improvements which in caused to reduce fraud, enhance security and accelerate the routines issues. In the past, in order to identify the crime and the criminal, fingerprints and portraits detecting procedures were used but these days a mechanized system is established to do so. Biometric technology can be divided into two general categories (Figure 1):

    1 - Physiological biometric techniques
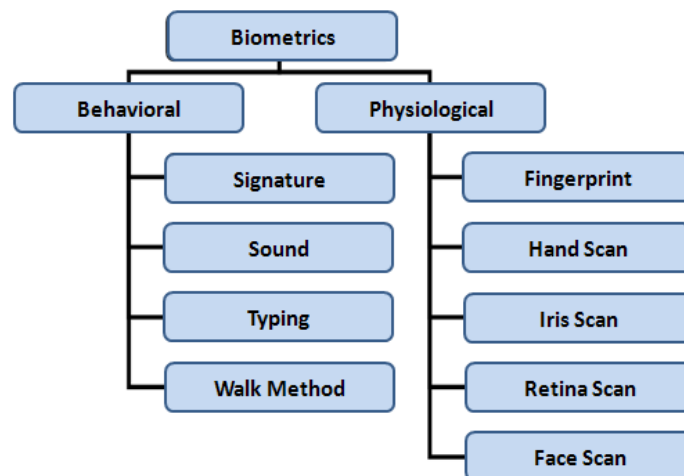
    2 - Behavioral biometric techniques

Figure 1: Variety of methods to help identify the biometric features

Behavioral biometric technique has four main sections:

    1– Sensor Block: responsible for receiving biometric information

    2- Extracting Features Block: it takes the taken information to extract its vector features

    3- Comparing Block: responsible for comparing the gained vector with templates

    4- Decision Block: this section identifies identity, so either accept or reject identity.

Biometrics science is seeking a way to identify people - unique features - related to the human body. It is expected that this method be better than previous traditional methods. In practical applications, the performance of system is: The balance of giving the wrong diagnosis (FAR) and the percentage of not giving the wrong diagnosis (FRR). A good

biometric identifier that can be used as biometric features in the system should have the following characteristics:

1- Uniqueness: Each person is unique and has the distinctive features with others.

2- Extracting accountability: the feature could be gained quickly and without the need for high processing for each individual case.

3- High resolution capabilities: the difference between two persons is too different to be easily separable.

4- Sustainability: the extracted features remain unchanged over time and due to changes in a person's life.

In continue and according to Figure 2, we will be introducing some of the most widely used biometrics.
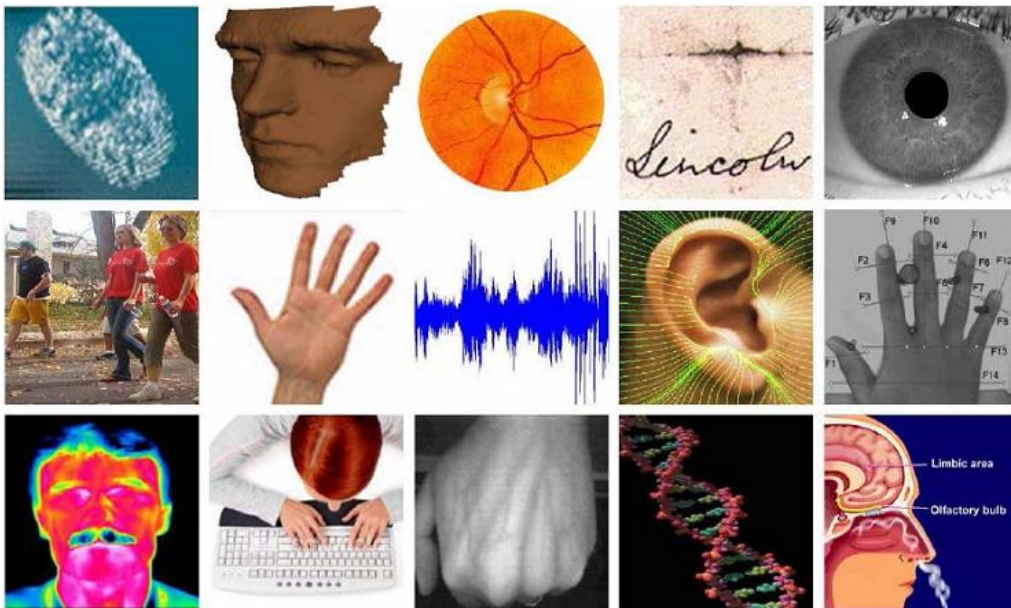

Figure 2: some of the most widely used biometrics

2- IDENTIFICATION OF PEOPLE BASED ON THEIR GAIT

Numerous methods have been presented to identify the identification of people based on their gait in video images which they can be classified into two general categories: statistical approaches and model-based approaches, the proposed approach consists of three phases: pre-processing, feature extraction, and recognition. Evaluation of this approach shows that usually a simple background removal algorithm is done in the preprocessing phase and no serious work has been done in this phase. In the proposed method to identify people from their gait, the pre-processing is used in order to accurately estimate of the background and

for object detection of the new approach based on fuzzy sets, and in recognition phase a new algorithm is used based on Warping Dynamic Time. DTW is a method based on dynamic programming technique for non-linear time normalization. In this method, the Euclidean distance of each sequence of feature vectors extracted from the test image is calculated with the each component of the reference sequence of feature vectors [2].

3- FINGERPRINT IDENTIFICATION

Fingerprint identification is the oldest and best-known method of biometric identification for individuals. But, however, the fingerprint identification has been subjected to major changes in recent years. In the new methods-instead of stamp and paper - special scanners have been used which has the ability to assess and adapt the fingerprint with recorded samples. Each person has a different fingerprint. Fingerprint identification is one of the most common methods of identification; so that even the staff attendance systems and some new laptops have been used this method as a reliable and rapid method. On the other hand, there are some practical problems in fingerprint identification systems. Due to the elasticity of the skin, there may be distortions in the shape and location of the fingerprint. In addition, high reliability and real-time processing are important factors in automatic fingerprint identification. To solve this problem, plug extraction from fingerprint images and its application in fingerprint matching is examined [3].

3-1- Fingerprint analysis methods

Not all images are fully maintained to minimize the fingerprint data in a database. First, the entire image is analyzed, and then its key points are stored. This action is very important to a quick search in databases. Each fingerprint image has about 35 important features such as cross points, end points, forks and so on (Figure 3) which so-called "minutiae". To detect and notify any fingerprints with certainty 8 to 22 features are sufficient. The fingerprint profile is stored either directly on the workstation or on a server or on a smart card.
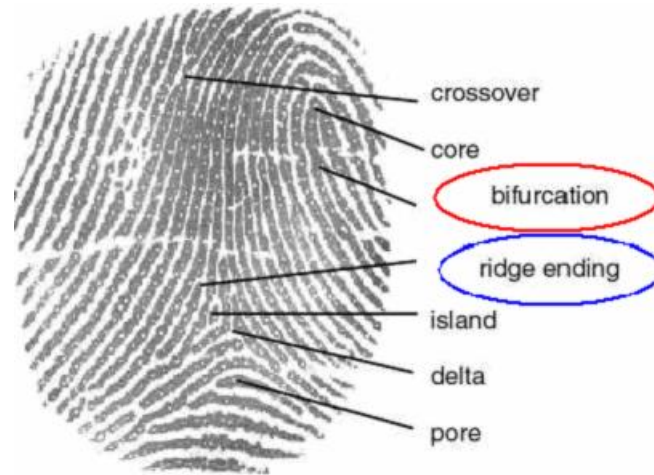
Figure 3: features of the finger

3-2- Fingerprint Classification

Classifications of fingerprint are used in identification systems. The goal is to classify a fingerprint database can be divided into smaller parts as possible. In identification systems, the only part of the database is searched that correspond to the categories in terms of the input fingerprint. In systems that work with low population, a class can be used which fingerprints belonging to a single individual characteristics to determine or verify identity. Setting a classification for fingerprint takes place according to the edges direction around the core as well as the number of the core and delta points. In a few cases, a fingerprint cannot be attributed to a particular class, so in any classification system a class is considered to be "unexpected classification" and such these fingerprints are fall into this category. Fingerprints are divided into five main classifications:

1- Arc

2- Diagonal arc

3- Left ring

4- Right ring

5- Spiral

3-3- Identification using hand geometry

A CCD camera is used to record the key points of hand in the identification by hand geometry. In this method, the hand's images are obtained from top and side direction and then are being processed. During this process, some points and lines are assumed on the image. The points and lines are used to measure the length, width and thickness of each of the fingers. Identification system then stores the data in a database until then it is compared

with the input data to identify the person. The geometric method is not sensitive to dirty hands and so is a good application for workers. Another advantage of this method is its independence of the police and criminal matters so that makes a lot of people willing to sign up in such systems and therefore is suitable for access control applications. It is claimed that it is not possible to indentify the image of one person's hand among many people and is limited just to confirm the identity of an individual which leads to inefficiency of search applications.
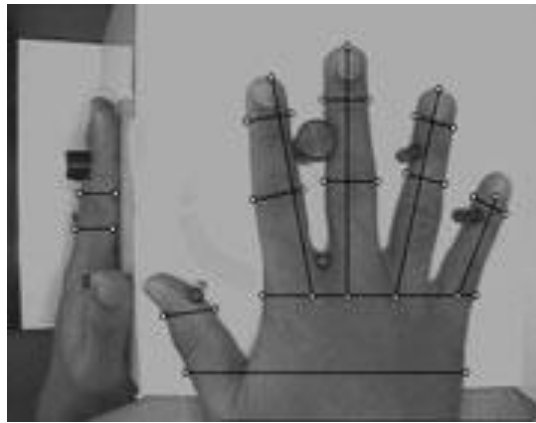
Figure 4: Identified by hand geometry

3-4- Vein Pattern

In this paper, a new method is presented for identifying individuals based on the image of the vessels. This method is useful for access control systems under network coverage(Fig. 5).
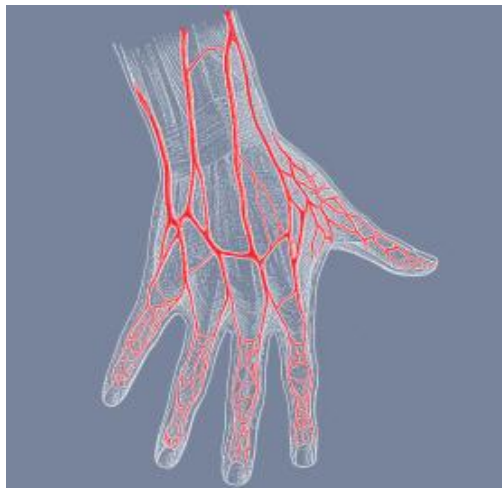
Figure 5: The condition of the vessel

This study was conducted in two stages: registration and data collection and the approval or recognition. In the registrar phase, N numbers of hand images are collected using near-infrared imaging for different individuals as core academic subjects. The images are being

processed in pre-processing, feature extraction, and modeling stages so that the adaptive samples are generated and then the neural network is used for the verification.

In the discussed method, the preprocessing consists of Image detection threshold, edge detection, edge removing, skeleton extraction vessel, resolution enhancement using morphological functions. In the feature extraction stage, the required vectors are needed to be prepared after applying the wavelet transform to image and statistical feature extraction for comparison in authentication phase. In fact, this technology has been brought a new experience in identification technology and only by using hand vein (vein Pattern the image is obtained by the CCD camera [5].

3-5- Identification by voice

In the identification by voice method, first, it changes and then compares it with the reference data. Identification by voice methods are expanding so that its affiliation to a specific text goes away.

In voice recognition contexts, most people think about voice frequency and oscilloscopes, although the new technology is using "sound spectrogram" devices.

In fact, sound spectrogram makes a graph visible and shows sound frequency on the vertical axis and shows the time on the horizontal axis. In this case, each sound/voice will have its own special graph. To increase accurately and acoustic sound quality, the device uses colors and shadows to show the graph. Since the act of speaking is dynamic and changeable, even the smallest factors – such as flu-like voices- may result in altering the sound and low-clarity. But some factors such as accent, emphasis on words or speech rate have almost no effect on this process. An overview of speaker authentication system is shown in Figure 6.
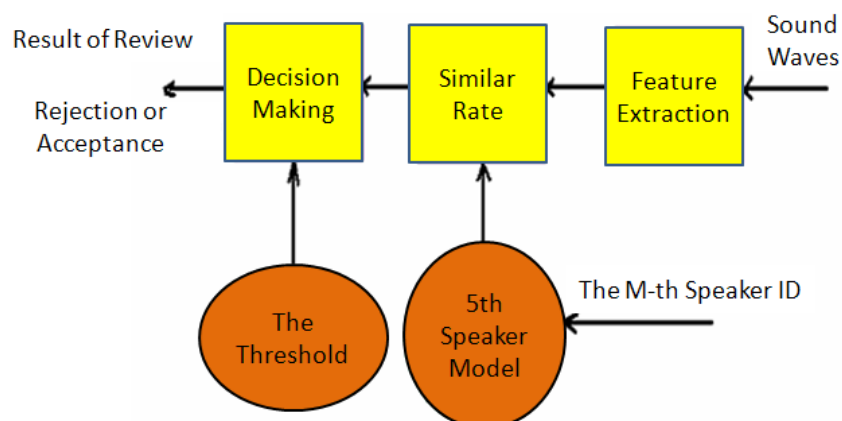

Figure 6: An overview of speaker recognition systems

3-6- Detection of the signature

The detection of the signature method analyzes the writing mode of the user. In this method, the case of written directions in X and Y as well as the change mode of the pen pressure is assessed. To do this, motion and pressure sensors are either under the paper or within the pen. As mentioned, the sensor has achieved pressure, direction and speed. Then, data are being processed and a simultaneous vector is created and the data of the vectors are compared with the original one. Signature recognition methods are divided into two main groups: static (off-line) and dynamic (on-line).

Static methods are considered a signature as two-dimensional image which do not contain any information that is time-dependent. Accordingly, the static properties of the signatures is time-invariant, are used to verify the signature. As a result, the signature recognition action becomes a regular pattern recognition process. Given that the change in the signature pattern is inevitable, signature verification process in this method can be limited to identify and map area of major changes [6].

3-7- Identification by key typing mode

Identification on key typing mode is one of the newest biometric identification methods. To do this, the user is asked to type a password or a specified text. Systems analysis the intervals between each key and the generated data are stored as reference data. For the function of the system at least eight characters are necessary but 12 characters or more is recommended. These characteristics can vary from one to six string such password, user name or e-mail. To maximize accuracy, this method combines the spreading technologies. The more times the user logged into the system, the more accurately system identifies her/him. The average error rate is three percent.

3-8- Face Scan

Sound/voice scanning is fundamentally different from other ones. In this method, the obtained sample should be three-dimensional. For this purpose, 3 set cameras which make a 90-degree angle or a moving camera that forms a semicircle whose center is the face of the concerned person has been used and then a three-dimensional image can be generated by the related software (Figure 7). The position of the eyebrows, eyes, nose, mouth, chin and forehead and the distance between the eyes and the eyebrows are recorded on the generated image and then being compared with stored samples.

Figure 7: Three-dimensional face recognition

The method is implied significant cost due to the use of expensive hardware and software but, however, the reliability is high. This method – just like palm scanning method- requires updated information.

3-9- Retinal Scan

Retinal scanners are using low-power infrared laser and cameras to identify information patterns on retinal blood vessel. In this method, to obtain a focused image, eyes should be placed close to the camera. Reference models are very small (typically 35 bytes in most commercial systems). Recent medical research has shown that retinal characteristics in contrast to what was previously thought, is not sustained and changeable due to some certain diseases. Many people are afraid to put their eye close to the light source. Therefore, this method is replaced by iris scanning.

3-10- Iris Scan

The formation of iris begins from the third month of embryo and on eightieth months is quite stable. The complex appearance and structure (pattern) of iris allows us to extract comparable features of it. Imaging of the surface of the iris is not much difficult but it should be consider carefully. For example, if the ambient light is changed or the rotation angle of the eye is not appropriate as well as the contrast, resolution and image focus is altered; then the possibility of error is considerable. This method also has the ability to detect identity.

Figure 8: Iris image

Each person's iris is unique and different with other people in terms of color and texture. Hence, iris scanning is an appropriate method for individual identification. In the method, the colored part of the eye is scanned and analyzed [7].

3-11- Identification by heartbeat

Researchers at the University of Wisconsin - Madison have found a new biometric technique for identifying persons. The researchers have based heart palpitations as a pattern. They have found that each heart has its unique beating pattern. They have been used this pattern to create a biometric method to identify people. Like all biometric methods, the system first generates a template of the heartbeat. To do so, a special feature is used which can be collected with conventional sensors such as ECG. Then, the cardiograph key data are stored in a database for future comparison. To maximize the reliability of this method, pre-processing and pre-screening operations are particular important. At this stage, the filtered heartbeats will be processed and stored in a database. The accuracy and reliability of this method is still not enough and is still in its infancy. But the researchers are confident that the identification by heart beating is completely possible.

4- CONCLUSION

Biometrics offers a reliable and incontrovertible method. The method is very successful specially when dealing with critical data. This method can be utilized in the electronic election and has many applications as well. The process is accomplished in several ways including determination and authentication through fingerprint, signature, face, eye scans, voice, and so on. We hope that this new science and technology can be applied on all financial, banking, passport operations and so on.

5- REFERENCES

[1] A.Daliri, A.Assareh, A.R.Rezaei, Y.Shekofteh and S.jafari, "Biometric", Online Database of Biomedical Engineering, Dezful, A graduate seminar, Amir-Kabir Industrial University, Department of Biomedical Engineering, 2007.

[2] A.Amiri, M.Fathi and R.Taheri, "Provide a new approach for identification of individuals based on gait improved DTW algorithm and fuzzy sets", Fourth Iranian Conference on Machine Vision and Image Processing, 2007.

[3] F.Jain, R. Bolle, and S. Pankanti, "Biometrics Personal Identification in Networked Society", Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow, pp. 1-64, 2002.

[4] A.K. Jain, A.Ross, and S. Pankanti. A prototype hand geometrybased verification system. InProceedings of 2nd Int'lConference on Audio- and Video-based Biometric Person Authentication, pages 166–171, March 1999.

[5] S. Zhao, Y.-D. Wand, and Y.-H. Wang, \Biometric identification based on low-quality hand vein pattern images," in Seventh International Conference on Machine Learning and Cybermetrics, Kunming, 2008.N.

[6] Miura, A. Nagasaka, and T. Miyatake, \Personal identification device andmethod," US Patent #2005/0 047 632A1, 2005.

[7] H.Mehrabian, "Identification based on iris image analysis", Master Thesis in Electrical Engineering, 2007.