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Biometrics in Modern World: A Review

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Abstract: - Biometrics is the science of measuring physical and/or behavioral characteristics which are unique to each individual and they verify that an individual is who he or she claims to be. So it plays an important role in identification and authenticating a person for immigration, physical, forensic and computer society. This paper is an detailed overview of different type of biometrics system and different areas of biometric system.
Keywords:- Biometrics, Characteristics, Enrollment, Verification, identification, Unimodal, Multimodal.

1. Introduction

As with the growth of Information Technology, the requirement of the security becomes a prime issue in IT. The security can be managed in number of ways. One way to better security is by identifying or verifying the person with technique named Biometrics system that can identify a person based on their biometric characteristics or traits.Characteristics, which can be measured on a part of the body at some point in time (passive), are physiological biometrics. On the other hand, characteristics, which are learned or acquired over time (active), are called behavioral. The biometric traits are of different types like Physical traits (finger, face, iris, ear, hand geometric, palm prints etc.) and behavioral traits (speech, gait, key stroke, signature etc.)[1][2]. These characteristics are important to identify a person. Figure 1 shows the some types of biometric which are commonly used.

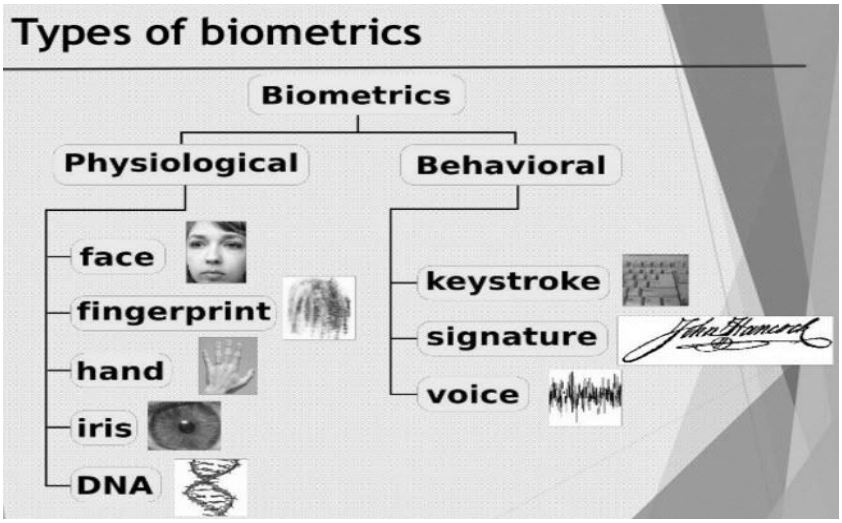

Figure 1:- Types of Biometrics

1.1 Characteristics of Biometrics

The feature of the human body to be considered a bio-metric it must follows the following characteristics; [3][7]

Universality: Each person should possess a valid biometric trait.
Uniqueness: The given biometric trait should be unique in comparing population.
Permanence: Biometric characteristics must be permanence.
Measurability: characteristics should be quantitatively measured.
Performance: The biometric trait must contain the essential accuracy imposed by the application.
Acceptability: The chosen biometric trait must be accepted by the system.
Circumvention: Refers to how easily the system can be compromised.

Authentications of the person for different purpose are very important due to security. The traditional methods are like token based and knowledge based techniques are vulnerable (easily forgotten or lost) and don't provide a high level of security. In the real world for different security purpose the biometrics data are more reliable and secure technique.

2 Overview of Biometric

Biometric is basically a pattern recognition system that acquires data, calculate vector of feature set and identify a person by compare the feature set with the template stored in the biometric device's database.

A unimodal biometric system uses a single trait to identify person which cannot sufficient to provide higher level of security. This biometric system is easy to use but some security issues. Generally this biometric system is used for application related to attendance [4][5][6]. The problems with unimodal biometric are:-

a) Noise in sensed data.
b) Distinctiveness
c) Non-universality
d) Spoof Attacks

Multibiometric system consolidates the evidence presented by the different biometric sources. Multibiometric system categorizes in different types of biometrics based on the way the system use the biometrics traits.

Multi-biometric systems use five different methods for solving single biometric disadvantages:

Multi-sensor: use two or more sensors for acquires data from one biometric. (Fingerprint image with two optical and alter sound sensors).

Multi-presentation / sample: several sensors capturing several similar biometric traits (Multi fingerprint image from multi finger of one person).

Multi-instance: the same sensor acquires multiple instances of the same biometric traits (Different position face image).

Multi- algorithm: the same sensor is used and acquired data are processed by different algorithm and compares the results.

Multi-modal: use two or more different biometric for authentication.

Multimodal biometric system use two or more biometric traits for identify a person for which identity they claims. The multimodal biometric system covers the mostly limitations of unimodal system[2][6][8][9].

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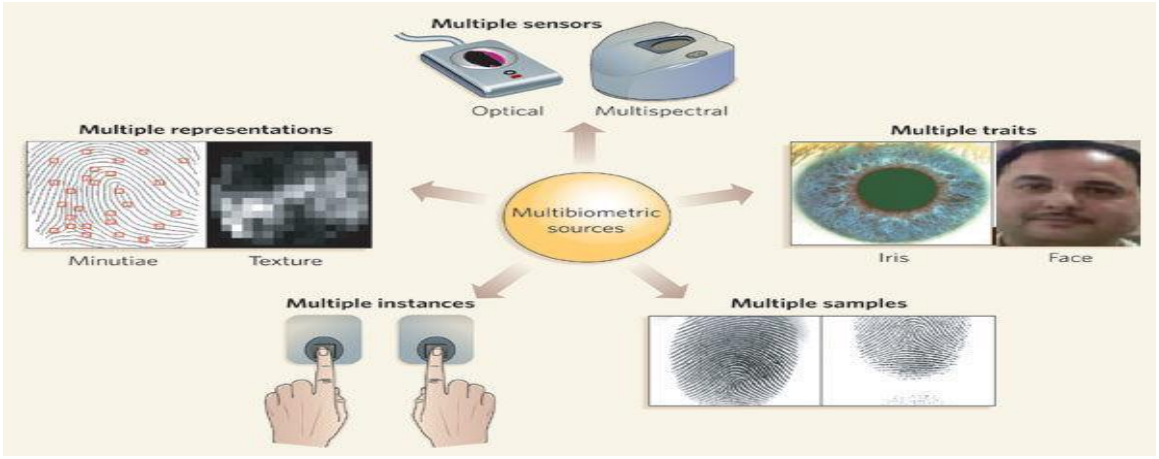

Figure2:- Multibiometrics system

3. Component of Biometric System

A biometric system has four major components:-
(i) Sensor Module- acquires data from individual.
(ii) Feature extraction Module-extract feature set from acquire data.
(iii) Matching Module-matching score is calculated by comparing the feature set with database templates.
(iv) Decision Making Module-person's identity is established.

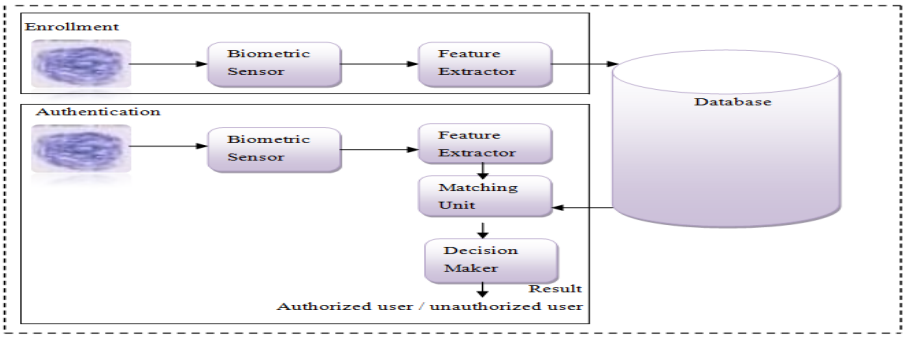

Figure3:- Block Diagram of biometric system

The very first time a person use biometric system is known Biometric enrollment. In this phase biometric data of the individuals are capture and stored in the biometric database. The sensor is the interface between the system and the real world, the sensor acquires all the biometric data by which an individual can identify.
Biometric has two operation modes in context of applications: verification mode and identification mode. Biometric verification means system validates a person identity bu making a comparison between the acquired data and the biometric templates of that person stored in the database. The verification is one-to-one comparison for identify a person.If the acquired data and the template of the same person stored in the database are matches then the person identify as a genuine otherwise rejected as an imposter. Verification used to positive recognition aimed to prevent different individuals from using the identity (A. K. Jain and A. Ross 2003).[12][13][15]

In identification mode of biometric system enrolled data sample are compare with the all templates stored in central database. This mode is typically used for negative recognition aimed to prevent an individual from making use of two or more identities.

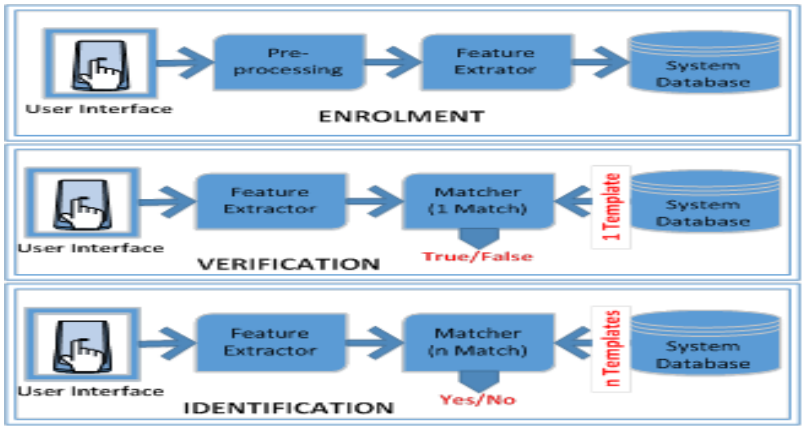

Figure 4:- Block diagram of enrolment, verification, and identification.

4. Related Works

Many studies and works have been done on biometric technology to provide better security over different frauds. The most commonly used biometric fingerprint dates back to 1891 during the collection of criminals fingerprint in Argentina by Dr. Jaun Vucetich. In 1994 the biometrics is deployed in the civilian and government applications which raised security and privacy related statements some are like will data of an individual stored in biometric used for tracking that violate the right of privacy, biometric data used for intended purpose, the medical data of an individual is used or not[15]. In 1858, Sir William Herschel capture the hand images for identify the employees at payday. A method names Anthropometries is developed in 1870.Sir Edward Henry, who is works as an inspector in Bangal police search a method to replace the anthropometries FBI and other criminal justice organizations use their research for evidenced collection. In the year of 1903, New York state prisons started use of fingerprint. The concepts of Iris pattern for authentication proposed by an Ophthalmologist Frank Brush later on 1936. The first model of speech recognition and face recognition came in existence. After 1970 the biometric models like face recognition and signature are compatible enough to identify an individual. In 1992, Biometric Consortium is established in US Government

After this the biometric technology were grow vastly and many different biometric traits sere used for authentication and new optimized algorithms are developed for enhancing the performances of the biometric system. Mid of 2008 the US Government begin use of biometrics data for different security purposes. After 9/11, fingerprints were collected from the location and they were matched with a GITMO detainee. To identify Osama Bin Laden DNA biometrics was used. Todays, the most famous brand of smart phone uses the biometric for authentication after 2013.In Recent time, heart (electrocardiography) and brain (electroencephalogram)based biometric features are noticeable concepts for authentication purpose. This is a futuristic technology has advantages like it is more secure than the token based and knowledge based authentication methods. This is not a 100% secure method but provide higher level of security than others. By using the Soft Biometrics the level of security and performance of biometric system can be increase.[9][10]

5. Role of Biometric In Modern World

In modern world the biometric system plays very important and different role for identify an individuals. The beneficial advantages of biometric technologies are high reliability, maximum protection from unauthorized access, and simplicity of use.Basically "the role of biometric" is taken as "the uses of biometric for authentication (verification and identification) of individual in the modern world. This technology does not provide 100% security and privacy but more than the other traditional security mechanism.Different biometricused for different applications,some of them biometrics technologies are given below.

(i)Facial RecognitionBiometric;
(ii) Fingerprint Biometric;
(iii) Hand GeometricBiometric;
(iv) Iris Pattern Biometric;
(v) DNA Biometric
(vi)Voice Recognition;
(vii) Gaits Recognition;
(vii) Ear Based Biometric;
(ix) Palm Prints Biometric;
(x) Vein Geometric Biometric;
(xi) Key Stroke Based Biometric;
(xii) Signature Biometric and so on.

Today, biometric technologies are used in different areas like work entrance organizationduring payment transactions. Biometrics system applied in defense tools for securing e-business and banking transactions. Multimodal biometric used to enhance identification; therefore, the control is carried out based on multiple biometric traits, which provide full control over an unauthorized access [3]. The biometric technology is used for security of various systems which requires that the control is given to the individuals which is genuine otherwise prevent them to access the systems. After applied biometric, it also prevent from material objects and data reliability. Biometric can be applied in diverse areas like access to work space, data protection, access to certain resources, access to inter-network resources, airport security, identify a person during entry in Government Offices and also applied for terrorism and crime control.

Todays, there is a high requirement of security for e-business and e-government form different fraud and attacks on online systems. In India, the biometric is used in Aadhar, which used for different schemes and policies. Even in the examination for government recruitment, before and after the identification is performed by Biometric system.

Biometric technology is rising in popularity throughout the world with every passing day. From mobile devices to laptops, government agencies to multinational organizations, voter registrations to national ID cards, biometric is evolving everywhere in every aspect of our lives. Here, we will discuss about the top uses of biometrics in the modern world today.[9][11][14]

I. Smartphone Security:

Biometric technology rises as inessential security provider tool. The floodgate opened by Apple which uses the Touch ID to recognition a person by using their fingerprint. Most of the smartphone companies use this concept for their product. Different biometrics technologies are embedded within the modern smart phones.

II. Border Security:
Worlds most developed countries use the biometrics technology to tight their border security. Russia uses biometric technology for capture fingerprint and face recognition of the tourists from visa-free countries. Australian border guards use iPhones as biometric. Within the last for years the digital identification and biometric based security at border have increased estimably 71% of the developed countries.
III. National ID:
The biometric technology is using in most of the countries for providing a unique identification number to their people. Many countries have already adopted this technology including France, Germany, Colombia, Greece, Iraq, Morocco, Albania, Sri Lanka, Maldives, Ukraine, Malaysia, India, Indonesia, etc. Generally, a biometric national identification card is a easily portable document, consists of name, birth date, address, citizenship, religion, a unique number and biometric profile.
IV. Banking:
Today, Banking is more digitalized to reduce identity based theft and to minimize the hectic banking process. In India and some other countries, the biometric technologies are used for secure banking transection. But the developed countries use the biometric for banking purpose is widely increased. Asia and Middle East are also moving towards adopting the biometric technology.
V. Workforce Management:
In our everyday lives the top uses of biometrics will take a place among the Workforce management. There are multiple aims of using biometrics in workforce management such as identification management, time and attendance, point of sale access, etc.
VI. SIM Card:
Many countries applied biometrics for SIM Card registration to minimize identity frauds.
Several countries adopted biometric SIM card registration to prevent identity fraud. In India the SIM cards that are not linked to Aadhaar may be deactivated by the government. Thailand is going to adopt biometric checks for SIM cards throughout the country soon.
Bangladesh completes biometric SIM registration process.
VII. Hospital
The hospital maintains data of patients by their name and date of birth which are not good, by mixing up patient's files. To reduce the effort of finding right record into the mixing records. The biometric data can be used to identify the patient from the crowd.
VIII.Airports:
The biometric can be used to increase the level of security by applying contactless biometric SmartGets in airports.Los Angeles airport tried biometric for passengers face recognition.
IX. Law Enforcement:
The law enforcement agencies continue to adopt biometric technology to make their system strong. Many countries including US, UK, Russia, China, Japan, etc. have already benefitted from this technology for a long time.
X.Private Cars:
Transportation-as-a-Service (TaaS)/ Mobility-as-a-Service (MaaS) is going to replace traditional key system to unlock and drive a car very soon. Most automotivecompanies of the world are uses fingerprint and iris technology for security.These industries are developing cars which will

enable the use of biometric for recognizing the owner of the car. Yamaha developed a new motorbike that enables the facial and gesture recognition.

XI.Prison Secure:

For better track of inmates, many countries including U.S., Germany, England, etc. started applying biometric security for their prison security systems. This reduced the manual entry works for daily enlist processing. Every inmate enrolled in the biometric database system that would know their physical and behavioral characteristics, crime type, punishment, entry and exit date, duties, etc.

XII. Public Transports:

The demand of the face and fingerprint technology are increased public demand for many types of transportations include railways, taxicabs, plane, buses etc. Shanghai's metro had adopted the biometric for passenger's identification.

XIII.Blood Banks:

For reducing the duplicate issue, error in data entry and carrying a national identification card along with you, biometric technology is emerging in blood donation organizations.The Indianapolis-based Indiana Blood Center was take the biometric tool to minimize these problems forever and they have succeeded.India also trails for biometric blood bank management system.

XIV.Government Welfare:

Many countries uses biometric system to enhance the government welfare and many governments announced a biometric project, which will help them to reach the senior and disabled citizens to provide government welfare benefits.

XV.Election:

Many countries already applied biometric technology elections.This will prevent individuals for voting multiple times or voting in place of others absence.

6. Conclusion

The biometric system is capable enough to authenticate an individual and prevent sensitive data from imposter or any kind of fraud. Todays, biometric has become a most famous and useable technique for different security purposes. The uses of biometrics technology will be increasing in coming days. Because individuals or organizations are now more concerned about their security, biometric authentication can used to allow only authenticated people. However, biometrics are using in our daily life [21][22][23]. It's taken some times to familiarize ourselves with the biometric technology system. The biometric is not 100 secure technologies but provide higher level of security than the others traditional methods like token based and knowledge based. At the end we conclude the future of biometric are very strong and most of the countries adopt the biometric system for their different purposes [26].

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