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## **REVIEW ON DIFFERENT BIOMETRIC DEVICES: TYPES, USES AND AREA OF APPLICATIONS**

**OJO ABOSEDE IBIRONKE; & EBISIN A.F**

*Computer Science Department, Ogun State Institute of Technology, Igbesa,  
Ogun State.*

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### ***Abstract***

*The great advantages offered by biometric cannot be compared with the traditional techniques of individual recognition. Why biometric replaces the traditional techniques where password, pins, pattern, card, token and object are commonly used for identification, verification, and authentication. Biometric has been a sustainable method recently and this has drawn more attention and also enhances its areas of application. Researchers have written substantial papers on different aspects of biometric. This paper tends to open our eyes to different types of biometric, their uses and the areas of applications.*

***Keywords: Biometrics, Application, Modality, Individual Recognition***

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### ***INTRODUCTION***

The frequent need for a suitable and reliable recognition system for detecting and verifying individual or personal identity has made the use of biometric a paramount research area in recent years. Biometric has proved authentic by allowing a rightful user to be validated and not anybody else, it also helps to identify individuals based on what he/she is made up of which has provided an easy accessibility of people. This emerging technology has become globally acceptable due to its physiological or behavioural features of identification (Pankanti, 2013) where identification is made on personal traits or characteristics. It has helped to reduce the problem usually faced by the traditional technique which solely relied on the ability of a person to have a

recognizing information or fact. Unlike the biometric system that matches a personal trait with an existing template (Harris and Yen, 2014).

## LITERATURE REVIEW

### Definition of Biometric

Biometric is a popular and generally acceptable means of identification by people of the world. This has brought about the different definitions given to it by different scholars and authors. All these definitions show that the meaning of biometric is taking from two words which are physiological or behavioural traits of individual persons.

Biometric is a combination of two words which was derived from Greek words. The combinations of words are *Bio* which means life and *metrikus* meaning measure (Prabhakar, Pankanti, and Jain (2003). According to them, biometric is the process of recognizing person either by physiological or behavioural identity which is done automatically.

Harris and Yen (2002) in their paper described biometric as a behavioural or physiological traits that can be measured, captured and compared with another instances when verifying it. They further iterated that biometric is automatically identification, recognition and verification of an individual person using biological traits.

Jain, Ross and Prabhakar (2004) in their paper stated that biometric is a process that have to satisfy some requirements which include universality, distinctiveness, permanence and collectability. They further established that individual characteristic must be differentiated and distinguished by physiological or behavioural biological trait.

Biometric allows the rightful individual to have access to information which he/she requires or required by him/her. A biometric system is a pattern, image and object recognition system that verify, recognize and compare an individual or persons from a biological or behavioural traits or features (Prabhakar et.al, 2003).

Biometric systems work by getting some physiological or behavioural characteristics of a person, extract the distinctive features from the captured data or information and make a comparison between the distinctive captured features against the stored data in the database (Jain et.al, 2004).

### **Biometric in History**

Biometric has been used for many centuries through the use of biological features or characteristics such as voice, fingerprints, face etc. for the purpose of identification of people.

According to Prabhakar et.al (2003) Alphonse Bertillon a Chief Head of Criminal Identification Division of Police department in Paris designed a system where different and various physiological characteristics of human identity are used to recognized criminals. He continued his establishment by referred to 19<sup>th</sup> century where discovery of the significance of individual distinctive finger prints were recognized and this led to the idea of storing criminal fingerprints. More so In 1970s, several machines were designed to read fingerprints which brought about today's technology. In their paper, they mentioned that hand geometry machine was designed in 1985 by Sandia National Laboratories. But, the use of PIN, Password and Token are pronounced for any operation at any point. While, some of these ways of identification can be compromised there are distinctive characteristic of biometric that makes it generally acceptable and authentic over others (Jain et.al, 2004).

Numbers of different types of biometrics features now days for authentication and recognition purpose have been propose. Harris and Yen (2002) identify the following types of biometrics. Fingerprint which stands out from others due to the loop, whorl and arc to match a print. The Iris scanning examines the iris pattern which evolves round the pupil by opening or widening the pupils which is made of elastic fibre While, the hand geometry biometric type uses scanner to make a shot of the hand in a 3D. A template of the scanned hand is stored and this is used for verification and recognitions. The Retinal scanner scans the blood vessels of the retina by taking lots of different reading with a low light and the information gathered are stored in a database. Voice verification was pinpointed where some principal areas such as palate, teeth, vocal tract etc. of the mouth would be captured. And finally, signature identification that depicts how individual endorses through the way individual hold pen, press on paper, and write strokes and how the signature appears.

Jain et.al, (2004) itemized fourteen different types of biometrics which are used for different purpose and at different areas of application. While mentioning the fingerprint, Iris, Retinal scan, signature, voice and face as the major and

popularly known biometrics. They also added some other types of biometrics which are rarely used. These include;

### **Features of Biometric**

There are several features of biometrics which makes it unique and distinctive over the general known login in, password and token as said by Harris and Yen (2002). These features as;

- i. Trusted Sensor – This is used to make a biometric more secure
- ii. Different Levels Of Security – Biometric are secured at the different levels or points such as capturing point, transferring point, comparing point etc.
- iii. Valid Information – The need for information guarantee calls for valid and correct information.
- iv. Multi-User Friendly – There is provision of help made available at as there is a shared administrator account provision where multiple persons are required.

### **Advantages and Disadvantages of Biometric**

Due to the required reliable identify recognition of individual to check or determined person's authentication, there is need to ensure that the needed service are accessed by the rightful user and not just anybody else. The below listed points are itemized as the advantages and disadvantages of biometrics by (Jain et.al, 2004; Kumar, Polepaka, Lazarus, Krishna, 2018 and Lai, 2018)

- i. Unsharable - Biometrics cannot be shared, copied by either a friend or family members like password, login and even token.
- ii. Lack of Being Lost – Biometric cannot be lost or stolen by people like the case of token, card or pin etc.
- iii. Difficult To Forge - Biometric is difficult to forget compare to other knowledge based and token based methods.
- iv. Convenience – Biometric provides ease and convenience way of usage as there is no need for cramming numbers or fear of theft that makes changing of password and pins persistence.
- v. High Degree of Security- There is high level of security in the use of biometric compared to other methods such as knowledge based and token based.

While, the major limitation to biometric is COST of acquiring the devices and the implementation of the operation amongst others are hardware and software fault without overlooking the technical fault.

## METHODOLOGY

**Types of Biometrics** Different types of biometric modalities have been design in the resent years, and all these biometric modalities classified as physiological or behavioural biometric. Those under physiological biometric include iris, finger, face, pal vein recognition while others under behavioural modalities are signature, voice recognition etc. the below types of biometric modalities are the most popular and often used biometric.

1. **Fingerprint Recognition:** device takes the scanning photograph of an individual's fingertips and record the features such as the Whorls, loops ridges, furrows etc. Its processes involve Minute based, Correlation based and ridge feature base. It is reliable, and secure biometric modalities. It was one of the first and old biometric.



Fig. 3.1 Sample of Fingerprint Device

2. **Face Recognition:** This method get face images through camera and analyse the facial features like the distance between the forehead, eye, mouth nose etc., the measurement are stored in the database for further verification, identification and recognition.



Fig. 3.2 Sample of Face Recognition

3. **Retina Recognition:** Retina is an internal organ that protects eye. This type of biometric uses infrared technology to capture the uniqueness partter of person's retina blood vessels.



Fig. 3.3 Sample of Retina

4. **Deoxyribonucleic Acid (DNA) Recognition** - is a biometric type used in the area of forensic application for person's identification with a unique code for recognition. This type of biometric modalities is used to get biological information of a person (pathological information) and is done with the use of very high accuracy.

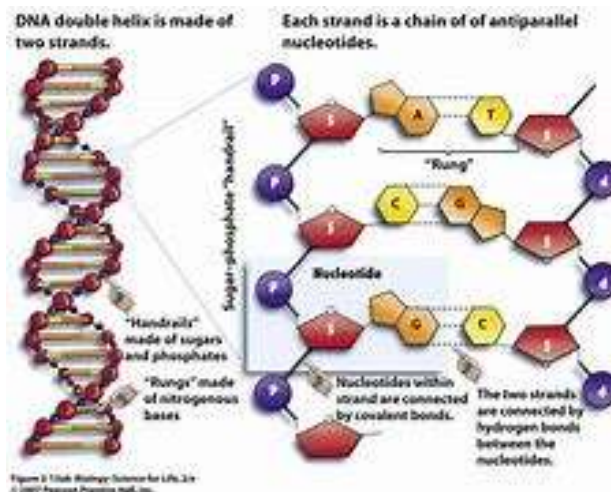


Fig. 3.4 Sample of DNA

5. **Iris Recognition:** Iris recognition analyzes the iris characteristics including rings, furrows, freckles that is situated in the colored tissue around the pupil. Many recognize it as one of the suitable biometric technology for identification and recognition. Iris scanner usually contains a video camera, glass and contact lenses.

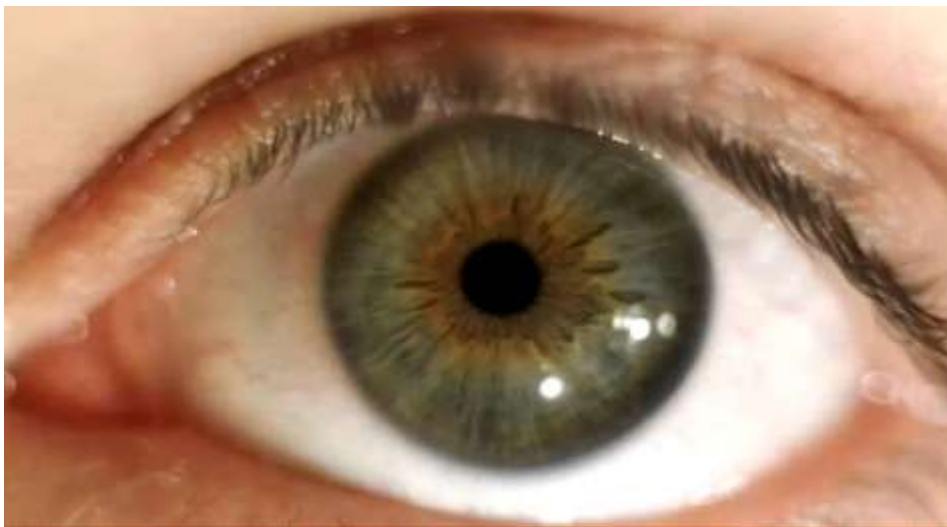


Fig. 3.5 Sample of Iris

6. **Speech Recognition:** speech recognition is a mixture of physiological and behavioral biometrics. It captures the voice or speech patterns by speech processing technology, the speech processing system then analyses the frequency, nasal tone, cadence, inflection to recognize a person's speech.



Fig. 3.6 Sample of Voice recognition

**7. Ear Biometrics:** is used as biometric based on the structure and the shape of an individual ear. It was recommended that individual ear structure is distinctive and that makes ear a uniquely recommended biometric recognition. Recognition system is proving more and more interesting nowadays has virtually every biometric traits or characteristics of an individuals can be used to recognize them. This is one of the most accurate types of biometrics to validate a person. It is believed that the result provided by this system may be more accurate result than fingerprint result.



Fig. 3.7 Sample of Ear Biometrics

**8. Hand geometry recognition:** This works with the shape of an individual's hand characteristics. The hand geometry reader measures person's hand in several dimensions, stores the data for future comparison and measurement.





Fig. 3.8 Sample of Hand geometry recognition

**9. Signature Recognition:** This is behavioural types of biometric that works in static and dynamic ways. This recognition system checks the way someone signs his name. The signature biometric based on some metrics like number of interior outlines and number of vertical slope components



Fig. 3.9 Sample of Signature

**10. Handwritten Biometric Recognition:** is a behavioural type of biometric that is close to signature recognition. This system of identifying a person by his/her way of writing. It can be categorized in two parts which are static and dynamic.

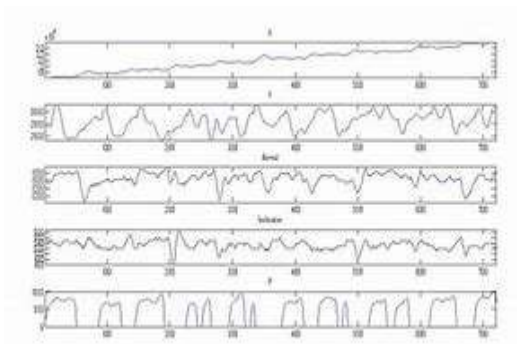


Fig. 3.10 Sample Handwritten biometric recognition

11. **Eye Vein Recognition:** is a type of biometric modality helps in video images pattern-recognition techniques to scan the veins of a person's eye. The veins are distinctive structure that makes eye vein recognition as one of the most accurate biometric authentication systems.

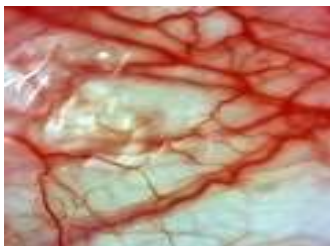


Fig. 3.11 Sample Eye Vein

Several many other biometric recognition system have surfaced and are in used. These include;

**Skin Reflection Biometric** modality that several LEDs send light at various wavelengths into the human skin and photodiodes read the scattered light that is analyzed to perform the verification and the authentication.

**Finger Vein Recognition** works with the patterns of finger vein beneath the skin's surface and matches with the vascular pattern of a person's finger in other to acquire information which will be stored for further use

**Brainwave Recognition:** is a distinctive biometric modality that measures the signals provided by the brain to create a unique individual character set on the database. It is believed that it is a more accurate biometric identification and authentication system

**Gait Recognition:** is a biometric technology techniques that analyzes an individual by the way they walk. It is good in area of surveillance analysis. Is the way someone walks. Although, this may change over a period of time as a result of individual's weight, occurrence of injury in the leg etc. In the absence of those challenges, gait is also classified as a way of recognizing people.

**Odour:** There is general acceptance that individual human being, animal or object has a distinguishing chemical composition which may be used as a biometric. But, it is not clear and certain if the individual odour could be detected and verified.

### Uses of Biometric

The high rising of biometric nowadays is without measure. It has become more popular throughout the entire world and virtual used everywhere and anywhere. These are some of its used in the society. According to Mehedi (2018), there are lots of uses of biometric devices in nowadays system. These include;

1. **Country Boundary Security-** Most developing country have adopted the use of biometric devices such as fingerprint, face recognition system iris scanning etc. to constrict their borders and enhances their security controls
2. **Hospital** – The frequent missing up of patient’s information or files has made some hospital to adopt the use of biometric where individual patient’s facial image is captured and stored for further use, this will enhance their security system and reduce or eliminated the frequent errors that usually occur in record keeping.
3. **Private Car-** The design of the different services such as transportation –as-a-Service (TaaS) is a novel innovation that will replace the former use of key for locking and unlocking a car door before driving. The use of fingerprint and Iris scanning technology will enhance security in the nearest features.
4. **Public Restrooms-** The use of face recognition system in some public areas such as public washrooms, toilets and restroom is currently adopted in some country and this is as a result of stopping toilet paper stealing.
5. **Electoral Registrations Process-** Many country have adopted the use of biometric for their electoral process and election. Some use fingerprint as part of the biometric trait of a register member of the country while some country use both the fingerprint and the face recognition system.
6. **Financial Organisation-** banking as one of the financial institution is more and more digitised all over the world. Reduction in banking processes and, fraudulent act and theft is now being curb by the use of biometric. The use of fingerprint, palm print , face capturing and even eye scanning are not paramount for speedy, appropriate and reliable operations
7. **SIM Car Registration-** A lot of country has agreed to biometric SIM card registration in other to prevent fraudulent act. In some country they combined two to three different of biometrics such as fingerprints, palm

- print and face capturing for stronger security control. The use of all these biometrics have helped us to prevent fraud.
8. **Airports**-Several airports make use of biometric to improve their security and make the process more convenient. This is used to recognise passengers through face scanner device.
  9. **Laptop Security**-Some laptops are with fingerprint identification technology for authentication which is used to unlock the device and limit the access of the intruder or authorised users,
  10. **School**- The biometric use for security in the school premises now is on high increase from the pre-school to the higher level of education. This enhances the security control in the school and also prove efficient in the area of admission process.
  11. **Law Enforcement**- The innovation in technology of the biometrics has been a reliable bench mark for law enforcement agencies for reinforcing their security system. Biometric devices such as facial recognition system, fingerprints, iris and voice recognition are some of the relevant biometric devices used.
  12. **Public Transport**- finger print and face scanning are some of the biometric devices used in the area of public transportation such as buses, railways, taxis etc. this is used to recognize passengers.
  13. **Shopping Mail**- Some shopping mail have started installing biometric registration which will keep track of all their customers' information. These devices include digital signature, fingerprint and face scanning.
  14. **Smartphone Security**- Majority of the smartphone nowadays are integrated with fingerprint scanning which allow to recognise the genuine or rightful owner of the devices. Not only limited to fingerprint, some smartphones all use voice recognition, face recognition and other biometric types.
  15. **Workforce Organisation**- There are several reasons for using biometric modality in an organisation. These reasons ranges from attendance registration, identity authentication etc. and this has helped prevent security loopholes, truancy and high increase in the staff payroll which has resulted into an increase in the productivity and time utilization.

### Areas of Application of Biometrics

Several areas of application of biometrics emerge now days. According to Jain et.al (2004) and Prabhakar et.al (2003) biometrics have been grouped into three major groups which are;

- i. **Commercial Application** – The areas of application include internet Access, Distance Learning, Computer Network Login etc.

- ii. **Government Application** – Areas of application such as driver's license, Boarder control, Passport Booking and control etc.
- iii. **Forensic Application** – Areas of application such as Criminal Investigation, parenthood Identification, Terrorist recognition etc.

These may further be broken into;

**Surveillance-** This allows the behaviour of large crowds of people to be monitored. With the use of biometric devices criminals or missing children, or border control can be largely monitored.

**Access control:** It could be used to limit or restrict the access of people in a particular place or to a particular computer network.

**Attendance Management System:** It help to keep track of people and the time of hours they work. The use of fingerprint, face recognition and others is mostly adopted in this area **Ojo, Ojo and Oladejo, (2015).**

## CONCLUSION

The use of biometric will be increased rapidly soonest due to the fact that people are more likely to be security more conscious than before. More biometric modalities may surface as researchers never stop researching couple with several sophisticated technology that are being designed. The assurance that individual biometric cannot be lost, forge and be disclaimed has proved a biometric recognition reliable, efficient and acceptable over the traditional way of recognition.

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