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A Survey on Various Unimodal Biometric Techniques

Asif Mehmood[a,*], Bishwas Mishra[b]

[a]COMSATS University, Islamabad, Wah Campus, Wah Cantt-Pakistan

[b]Maharishi International University, Fairfield, IA, USA

Abstract

The agriculture plays very important role as it helps to accomplish the need of food among people. The production in agriculture consequentially contributes to the economy of every country. The grain crops rice, wheat, maize, and legumes are suffering a lot due to some viral, bacterial, and fungal diseases. The pest and variety of diseases can bring a heavy loss to the global economy. The monitoring of crops health and identification of diseases at early days is very challenging and emerging task in agriculture. So, it is very important to prevent crops from fatal diseases in the early stage, but the manual process of disease discovery can lead to erroneous magnitude of pesticides. The trouble is figure out by automate discovery of diseases and supplication of relevant medication on time. It is very necessary to find out accurate disease to overcome heavy loss to economy. From the few decades, to detect disease correctly, the process of detection become automate using emerging technologies and techniques using computer vision, machine learning and image processing. This article presents the extensive literature on existing methodologies utilized for recognition and classification of leaves diseases. The studies addresses that there is still many limitations and challenges find in different phases in plant disease detection system. The presented research also highlights the pros and cons of different techniques that help out the researchers for contribution in future.

Keywords: Classification, Grain Crops, Legumes Disease, Detection, Agriculture, fungal diseases.

1. Introduction

Agriculture address an active role as it is associated with production of essential crops. From some recent decades the research in the Agriculture sector allow to initiate effective approaches to increase the production with quality to meet the needs of economy [1] as the United Nations Food and Agriculture Organization (UN FAO) alarming report give the recommendation of increasing food supply up to 70% tomeet the future requirements [2].

E-mail address of authors: [a,*]*asifkhattak333@gmail.com*, [b]*bmishra@miu.edu*

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The field of agriculture builds giant contribution towards the GPD in Pakistan which show the developing progress in the country. The farmer's uses grains to produce the major grain crops and legumes. These grain crops and legumes having rich source of nutrients, minerals, dietary fibers that directly related to the humans heath and prevent from health disorders. But due to pandemic situation like COVID-19 it cause the instability in the economy; in such situation food security becomes the important concern of the modern world to secure the future supply, as according to United Nations (UN) report the population of the world increase by 8 billion people in 2023 and 10 billion in 2050 [3]. Due to some factors like non-identification and late detection of diseases can waste up to 40% of agriculture products [4]. The development of agriculture sector is very important for the prosperity of the nation. But the developing countries are facing a lot of trouble in agriculture due to the attack of different diseases on plants. The formers are not train and also not aware with the modern techniques used to cure plants. The strategy to prevent plant from diseases in the past is to uprooting the plant and the use of insects killer and pesticides. The formers were trained to detect and cure diseases in traditional manner that is not so efficient and the result is loss of crops that bring heavy loss to the formers as well as the economy.

Applications of Biometrics

For a higher level of security Biometric Identification Management Systems (BIMS) is being used. Belief, accessibility, reliability, and the pursuit for new technology and employ in their system for achievement of goals. Some common applications of biometrics are as follows.

- Uses in banks for authentication purposes.
- Used at airports for security.
- Identification at the national level.
- Used for law enforcement.
- Attendance and time.
- Embassies.
- Surveillance.

2. Biometrics

Biometrics has been widely used for recognition by researchers. There is a wide variety of methods that can be utilized for authentication or recognition of a person. There is a range of widely used biometrics.

3.1 Biometric categories

The human recognition through automized method is based on the images obtained through the different sensors and fed to the biometric system. The comparison of the image is carried out with the image stored in the database by some algorithms and the recognition results are displayed. Biometric can be separated into two groups:

(1) Biometric Based on the Biological Features
(2) Biometric Based on the Behavioral Features

*3.1.1 **Biometric based on the Biological Features***

Following methods are used to recognize a person through the biological features:

3.1.1.1 Fingerprints

The fingerprint is the elevations and valleys pattern of a fingertip used for the verification and authentication of a person. This is a very popular method because the cost of this method is low, and this is a reliable method for the recognition of an individual. This method is a unique, durable, accurate, and famous biometrics technique [10]. The archaeological evidence is existing which verifies, that the old civilization of Chinese and Assyrians utilized fingerprint for the identification of a person from 7000 to 6000 BC [11]. The fingerprints methods can be categories as based on correlation, based on ridges features, and based on Minutiae [12]. The system that is used for fingerprint recognition is called Fingerprint biometric security systems (FPBSS). The FPBSS utilizes a template for the matching purpose. The main problem of FPBSS is template matching [13]. Most fingerprint system uses the method based on minutiae [12]. The pattern of minutiae is unique but many factors affect the system performance such as noise and distortion which occur while acquiring the image [14]. To overcome this problem a method based on the ridge of fingerprints is used. The ridge is the pattern on the tips of the finger and origination, frequency, shape, and texture of fingerprint are used to match the fingerprints. But there is a problem of low perception capacity [11].

The method based on correlation uses two images overlaid of fingerprint and perform correlation for different alignments of pixels. The problem with this technique is non-linearity, misrepresentation, condition of skin and finger pressure, and alignment difference [15]. The ridges and valleys pattern can also be considered as oriented texture [12]. Jhat et al. [16] presented a system to address the problem of verification of fingerprint.

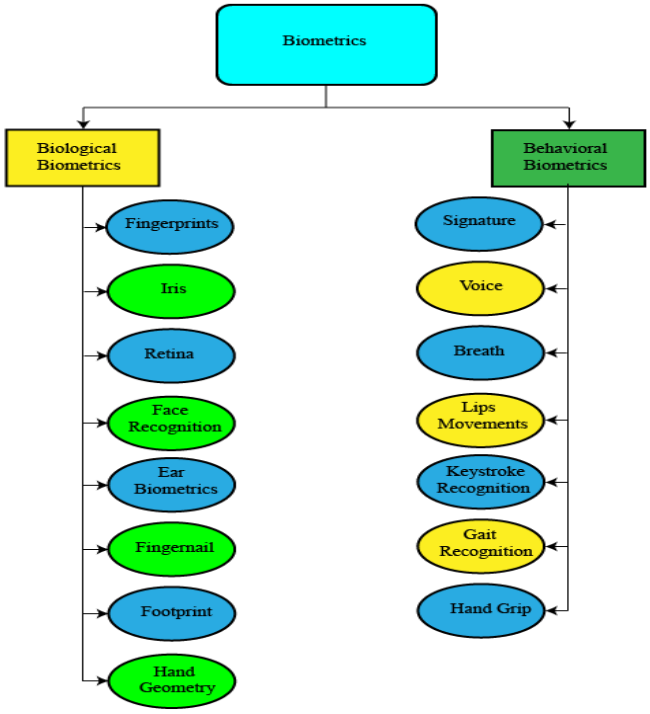

Fig. 1. Biometric Categories

3.1.1.2 Iris

Iris plays an important part in the system based on biometrics. The pattern of the iris is complex enough and helps to distinguish an individual. The pattern of the iris of an individual is different from other same as a fingerprint that can be used for recognition of a person.

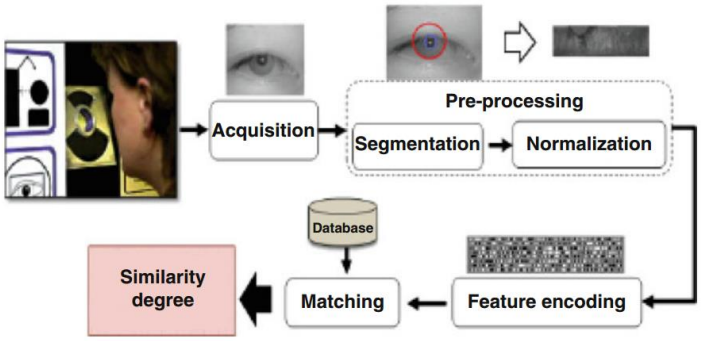

Figure 2: Iris Recognition System [21].

Wildes et al. [17] presented an iris-based system in which initially, a digest based on feature vector is developed, and later an identifier for biometrics is developed. A common device for the acquisition of iris image is used that is called iris analyzer. Iris scanner is also used for data acquisition. The iris analyzer acquires the iris image by minimizing the eyelashes. The features that originated from the iris are distinct as compare to fingerprint and face [18, 19]. This can be potential for individual recognition, but the problem increases as the complexity of the iris pattern increases [20]. The system for iris recognition is illustrated in Fig. 2.

3.1.1.3 Retina

The eye retina is a vital part of the human visual system, but it can also be used to identify a person because each person's eye retina has a unique construction of vessels of blood [22]. This structure of a vessel can be used for the identification of a person [23]. This is the second suitable method for authentication after DNA and the error rate [24] is also minimal. This method is cost-effective because data can be obtained through a simple digital camera.

3.1.1.4 Face Recognition

The recognition of a person from the face is a famous method used for authentication [18, 25-42]. It is easy to get data of an individual for his/her facial features rather than putting a palm on the scanner or placing an eye in front of a retina scanner for a retina scan. This method is also used for investigation purposes [32, 39, 42-49]. The recognition through the face is used for various authentication purposes such as national ID card, live investigation, passport, and so forth. In the process of face recognition, pre-processing is carried out that includes the standardization[26, 39, 49-55], resizing of the image[35, 56], and identification [25, 32, 43, 44, 50, 55, 57]. The image is retrieved from the database and used for perceiving before the pre-processing. Many factors include which drastically affect the system performance such as variations of posture, poor quality of image, noise, and many more. The face recognition system is shown in Fig. 3.

Fig. 3. Face Recognition System [58].

3.1.1.3 Ear Biometrics

Ear biometrics is the method used for the recognition of an individual from the physical features of the ear. The method is based on either 2D or 3D recorded image frames. The parameters that are used in the recognition process as shown in Figure 2 such as the geometrical shape, tips of the ear, universally used function for the image, locally used imaging function of the ear, and 3D models [59]. The ear can also be used for the recognition purpose because the ear of each person has unique characteristics and structure. The main advantage of ear recognition is that there is no effect of makeup on the image. Many researchers [60] are trying to find a permanent feature of the human ear that does not evolve with the passage of life.

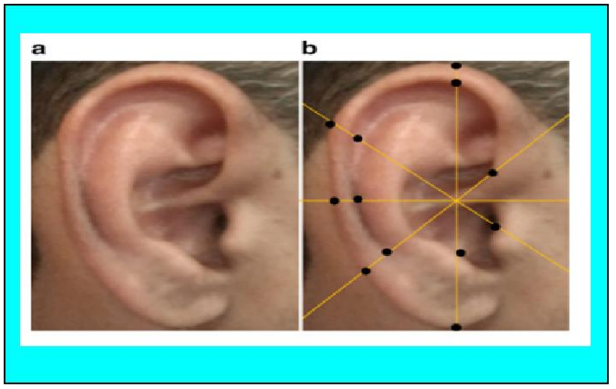

Figure 4: **a** Original Image **b** extracted Points for Recognition [3].

3.1.1.6 Fingernail

There exist a skin under the plate of the nail which is called the nail bed [61]. This nail bed is unique for each individual and can be used for recognition [62]. The images of the nail bed are acquired by a special system. The groove of the nail bed is utilized for recognition purposes. The surface of the fingernail is also used for recognition purposes [63]. The nail of the finger has specific data that can also be used for the recognition of an individual [64]. This method can also be used for verification at banks and security purposes. It is a very safe method that can be used for authentication because no one can easily change the data. The femtosecond laser pulse is a device that is used to obtain data from the individual. This data is later stored on a database and later can be used for the authentication process. An object detector [65] was proposed by the author in and the previous work was extended in [66] and was used for the segmentation of the nail prints.

2.1.1. 7 Footprint and Foot Dynamics

Another biometric [67] method that can be used for authentication of an individual is prints taken from the foot. This method is sometimes not convenient because bare-footed images [68] are needed for the authentication process. The sample of both the feet and recorded images are initially normalized and after that compare with the registered images. Some information may be losing during the process of normalizing; therefore, the geometrical feature of feet is also considered. The footprints techniques can be categorized into three classes based on their input types such as (i) sequence of data based on the walking footprints (ii) sequence based on standing pair of footprints (iii) sequence based on standing single footprints. The sequence of the walking footprint of a person is extracted in [69, 70] the method based on the walking sequence. The center of pressure is used in the Hidden Markov Models. Mate type sensors are used by authors in [71, 72] for extraction data.

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3.1.1.8 Hand Geometry

The hand geometry is the physical structure of the hand such as finger length and width, and the width of the palm. The main advantage of this method is simplicity and this method can also work in case of low resolution [73]. A detailed survey about hand geometry is given by [73, 74].

Another brief survey on hand geometry is given by [75]. Hand features are based on plenty of geometrical features that can be used in the recognition system. The main advantage of hand geometry-based features is that they are less variant. The hand features include the shape, width, and length of the palm [76].

A camera scanner is used to scan the geometry of hand in the hand shape biometric system. After that, the comparison is done between the captured hand geometry and the data stored in the database. The model of biological shape [77] and HCI tasks [78] based the gesture also utilizes the hand shape data. Handshape biometrics is easy to use because:

(i) The data extraction is easy and convenient for the user and the sensors are also inexpensive [79-81].
(ii) The low resolution is required for the extraction of the data [75].
(iii) This method is more suitable for the public due to no illegal association [82].

The types of biological biometrics and the features used in these methods are illustrated in Table 1.

Table 1. Biological Biometrics and Features

Biometrics	**Types of Features**
Fingerprints	Valleys of Fingertip
Iris	Iris Scan
Retina	Blood Vessels
Face Recognition	Facial Features
Ear Biometrics	Physical Features of the Ear
Fingernail	Nail Bed Features
Footprint and Foot Dynamics	The sequence of Walking Footprints
Hand Geometry	The Physical Structure of the Hand

In the fingerprint's biometrics, the valleys of the fingers are used to extract the features. While in case of iris-based biometrics, the iris scanning is used to compute the features. Blood vessels are utilized for the recognition through retina biometrics. Facial features are used in case of face recognition method. Physical geometry of the ear is utilized for the ear-based biometrics. Features of nail bed are extracted for the recognition from fingernail. Walking footprints sequence is used for the recognition through footprints. While in case of hand geometry, the physical structure of the hand is used.

3.2.2 *Biometric based on the Behavioral Features*

Following methods are used to recognize a person from the behavioral attributes:

3.2.2.1 Signature

To recognize a person through the signature is based on the behavioral biometric attributes [83-86]. A method based on pixel matching is introduced in [87] and it is utilized for offline verification. The mining of selective

attributes is used for offline authentication [88]. This method is based on physical activity and two different methods dynamic and static ways are used for the examination purpose. In the static technique, a person's handwritten signature is converted to an image by using a scanner or digital camera. Then, the data is transformed into the textual form and is utilized for verification through different machine learning and image processing-based algorithms. This is also referring as the offline method of verification. The dynamic method is based on the data captured through smartphones, tablets, and PDAs. This method includes the signature taken from the finger or pen. Various characteristics are used to verify a person such as a shape, pressure, stroke, and captured direction. The dynamic method is more robust because it is impossible to reproduce.

3.2.2.2 Voice

Voice is considered a powerful tool for recognition [89]. A highly secured area is needed for the recognition of an individual from the voice and this speaker tool is used to identify a criminal. A minimal clause is required for the recognition. Speaker tool is also used to identify a person remotely through some sensitive telephone. This method can be implemented in the field of defense, call centers, forensic, and security purposes. Mel-frequency cepstral coefficients [90] method is based on speaker and recognition is done through voice. Another method is based on wavelet and is considered more robust and accurate [91]. Another reason to trust voice is the simplicity. In voice biometrics, a person must speak naturally such as he may be asked for a telephone number, his/her name, or repeat some phrases. The voice can be easily delivered and most of the devices have built-in microphones that are needed to identify a voice.

3.2.2.3 Breath

Breath is a method used to uniquely recognize a person. It is an anatomic system based on the respiratory system. It relies on the intrapulmonary stress that is managed by the vocal tract, trachea, muscles of the respiratory system, diaphragm, and lungs [92-94]. Breath is also considered a distinctive identification because it has a structure that varies and is based on inner microbes. This method can also be used for medical diagnoses such as drug diagnosis or doping diagnosis in an athlete. This method is also referred to as breath print. The sound of an individual is recorded by placing a microphone sensor closer to the noise. If the pattern remains constant, then it can be used for recognition.

3.2.2.4 Lips Movements

Centroid and rotation movement of lips is an important type of biometric that is used for individual verification. The attributes of dynamic distortion shape and static [95] lips attain a high recognition rate. Video frames are utilized for the computation of the attributes as shown in Figure. Initially, the face of the person is detected in the video frames. After that, the mouth location is identified that can be used for identification purposes. In [96] the author that the features information extracted from the movement of lips can be used for individual authentication and this can be the efficient and robust approach. It can be observed that there is specific information in the lips movement of the speaker that can be utilized for authentication or verification purposes [82, 97].
The architecture of the Lips movement biometric is illustrated in Figure 4.

3.2.2.5 Recognition from Keystroke

The pattern of the keystroke is also for the identification of a person. Each person has a unique typing pattern [4, 85] that can be used for verification of an individual. The pattern of keyboard typing is used to monitor the different types of rhythms. The pauses between the keystroke and the duration of the keystroke can be used for authentication purposes. The regular string typing consistency ratio is high, and the error of the individual is unneglectable. The

architecture of the keystroke biometric is based on three parts: Data extraction attributes computation and mapping [8].

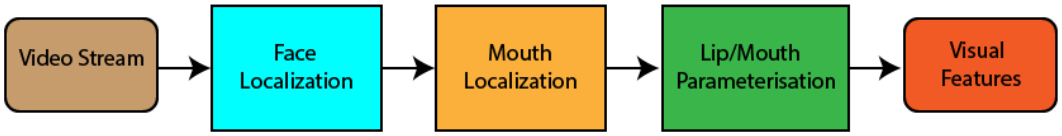

Figure 5: Lip Movement Biometrics [95]

The main advantages of this approach are no need for any equipment, it is very simple and easy to convey, it is a practical approach, end-user training is not required. This approach also has some drawbacks such as fatigue, a variation of writing pattern, injury, and change in the equipment of the console.

3.2.2.6 Gait Recognition

Gait can be referred to as the walking pattern of an individual [98-101]. Gait can also be used for the recognition of a person [26, 102-108]. Plenty of evidence is available which verify that each person has a unique waling pattern and cannot be copied. Human Gait Recognition (HGR) can be used for many purposes such as security, defense, video surveillance, banks, and embassies. The main advantage of HGR is no need for the collaboration of the person because video can be captured from the CCTV cameras installed at different places. Various factors drastically affect the system performance such as view variation, clothes changes, carrying things, and shadow problems [98].

The gait techniques can be separated into two groups. The method is based on a model [109] and a method that is model-free [110]. In the model-based approach, the movement of the body is tracked from various fragments of the human body. This method is more informative but is computationally expensive. The model-free method is based on the appearance of a person. This approach directly works on the silhouette of the human body and this is not computationally expensive. The system architecture is demonstrated in Figure 5.

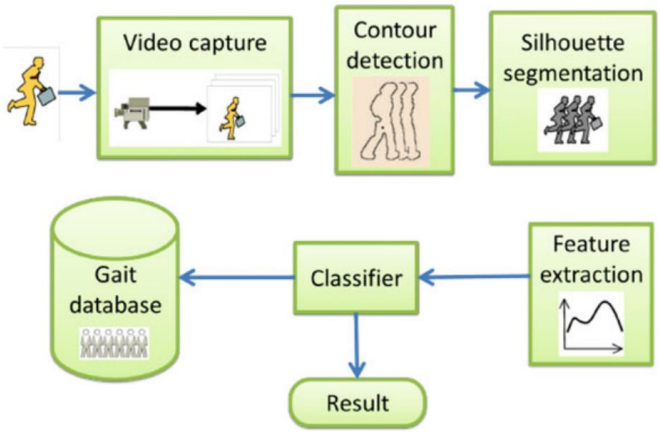

Figure 6: HGR based Biometric System [111]

3.2.2.7 Hand Grip

The holding capacity of the hand is referred to as a handgrip. The physical status of a person can be checked by the grasping ability. The handgrip can be used to judge health, age, dietary status, etc. The handgrip is based on age and the health of a person. The weight of the carrying things also affects the handgrip. Nutrition and diet experts also use the handgrip to check either patient is underfeeding or not [112]. Each person has their grasping pattern, but it can vary according to the health condition. Jamar electronic dynamometer can be used to measure the handgrip pattern of a person. Jamar dynamometer is a good option to be used for clinical purposes but it has the drawback of being unidirectional [113]. COTS are inexpensive and low-power sensors that are used for the detection of the firearm. Small sensors are utilized to measure the handgrip but it is challenging to be implemented on the whole firearm system [114]. The types of behavioral biometrics and the features used in these methods are illustrated in Table 2.

Table 2: Behavioral Biometrics and Features

Biometrics	Types of Features
Signature	Pixel Matching
Voice	Clause of Voice
Breath	Vocal Tract, Trachea, Muscles of Respiratory System, Diaphragm and Lungs
Lips Movement	Centroid and Rotation Movement of Lips
Recognition from Keystroke	Typing Pattern
Gait Recognition	Walking Pattern
Hand Grip	Grasping Pattern

Pixel matching method is used for the recognition through signature. In case of voice recognition, the voice clause is utilized for the recognition process. The attributes of Vocal Tract, Trachea, Muscles of Respiratory System, Diaphragm and Lungs are used for the breath recognition method. In case of lips movement-based biometrics, Centroid and Rotation Movement of Lips is utilized for feature extraction purpose. The pattern of typing is used in the keystroke recognition method. The features based on the walking pattern are utilized for the gait recognition. while in case of hand grip biometrics, the hand grasping pattern is exploited.

3. Conclusion

Biometrics denotes a technique that is used for authentication of a person from his physiological or behavioral attributes. This method of authentication is becoming famous day by day. The qualities of each person are unique and can be used for authentication. Even the qualities of both twins are not the same. There are a variety of problems that need to be dealt with. Plenty of applications are based on biometrics. The scope of unimodal biometrics is limited and its problematic. So, this problem can be solved by using a multimodal system of biometrics. Thus, by combing different types of biometrics, the authentication can be more robust and accurate.

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