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A Review On Digital Image Processing In Biometrics

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ABSTRACT

Digital image processing is the technology of manipulating pixels of the digital pictures to enhance the quality of the picture that is digital in nature or create a different perspective or to fetch information from the image digitally, with the utility of simple or complex computer algorithms. In this review, the digital image processing in the field of biometrics has been discussed. Several biometric applications and different types of biometric along with the role of image processing in biometrics are explained here. Digital image procession has allowed wide criteria of algorithms. That is used to the input biometric sample. The comparison of biometric images is made using image comparison techniques. The existing researches in biometric and their objectives are stated. This paper also discussed the scope of digital picture processing.

1. Introduction

Digital image processing [1] is a fast growing technology which is used to enhance the quality of a picture or an image. In computer science, the digital picture processing means the processing of the pictures which are digital in stuff by a digital computer by the use of computer algorithms. One of the subsets of digital signal processing is digital image processing. The digital signal processing is a branch of computer science in which signals are used for providing sensory data from the real world. For example, image sensors in the camera provide sensory data that are visual images. Whereas, digital image processing is used for manipulation purpose, for this different algorithm are used to perform image processing on digital images. At the time of processing, that allows vast bounds of algorithms that are correlated to the taking in inputs and can divert trouble such as signal distortion and noise. The graphics are described over two dimensions. So it is possible that digital graphics processing may be modelled in the multidimensional environment.

There are two types of operation that are done on digital image processing. First is low-level operation and other is middle-level operation. Low-level operations help to increase the quality of an image to upgrade the understandability. It includes the contrast feature, sharpening quality and so on. The middle-level operation includes two features. First one is feature extraction and other is image segmentation.

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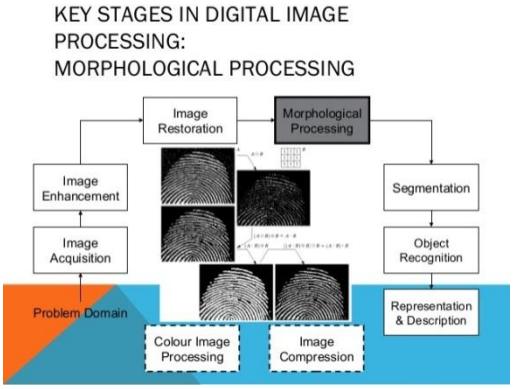

Fig 1 Digital Image Processing [14]

Processing of a picture includes renovation in its appearance and efficient representation. This regulation consists of not just feature extraction, analysis and recognition of images [6], but it also provides summarizing, refining and reestablishment. The complete process of picture processing and analysis starts from receiving of visual information to the giving out of the description about the scene. It can be divided into three categories as given below:

1. Discretization and Representation: Translating visual information into a discrete form that is suitable for computer processing, and approximating visual information to save storage space as well as time requirements at the time of subsequent processing.
2. Processing: This improves the quality of graphics by filtering. After that, it reduces the data to save storage space as well as channel capacity at the time of communication.
3. Analysis: it includes extracting image features; registration and recognition, quantifying shapes.

2. Related researches

There have been several kinds of research in the field of digital image processing techniques using biometrics. Some of those researches have been discussed below:

In 2000, P. Phillips et.al proposed FERET evaluation methodology. This methodology is used for face-recognition algorithms. Along with this, they discussed the IEEE Transactions on pattern evaluation and also explained the machine intelligence [2] Face recognition is a complex task because face rotations introduce occlusion of facial structure. This paper overcomes from two shortcomings, first is FERET database of face images and second is the establishment of FERET tests.

In 2001, Gerhard X. Ritter presented a book related to picture Algebra [3]. The field of this picture algebra is useful to provide some information related to background. This means

picture algebra is a mathematical theory that is concerned with the revolution and investigation of pictures. The main goal of picture algebra is the establishment of unifying and overall theory of picture transformations and picture analysis.

In 2001, W. Kong et al. proposed the accurate iris segmentation. That is based on novel reflection as well as eyelash detection model [4]. This paper concentrates on the reflection detection model as well as Eyelash detection model. This process of iris-scan initiated with any picture. A specialized camera that is very close to the subject provides and uses an infrared image and detain a photograph that is with high-resolution.

.In 2001, C. Lin and C.hang LIBSVM wrote research on a library for SVM in fingerprint [5]. A fingerprint in its narrow sense has been considered an impression. This impression is left by friction ridges of a human finger. It is possible to recover the fingerprints from a crime scene. Fingerprints are easy to set down on appropriate surfaces. It has been done by eccrine glands. Those have their existence in epidermal ridges.

In 2003 Li. Ma, and T. Tisse did research on Personal Recognition Based on Iris Texture Analysis [6]. They stated that personal identification for automation based on biometrics has been receiving great attention over the prior decade due to broadening attention on security. Iris recognition is becoming a very active topic in both research and practical applications. This paper described a method for iris recognition from a sequence of iris images.

In 2003 L. Masek explored recognition of Human Iris Patterns for Biometric Identification [7]. Biometrics has been considered the method to identify the human parts. Biometric is used to measure and analyze the behavioural or physical traits. A biometric system involves many applications with methodologies of biometric. That enables the identification of a human being automatically.

In 2014, Dr T. Karthikeyan introduced a paper related to Personal Authentication and uses the concept of 3d Face and Iris Images [10]. This paper overcomes from two limitations of the single biometric trait. The emphasis of this paper is on combine two biometrics i.e. face and iris biometric authentication system is analyzed and implemented in this paper. Score level fusion technique is used in this paper

In 2016, Kyle R. Corpus, D L Gonzales and Alvin moranda wrote an article in which they discuss the use of keystroke dynamics and accelerometer biometrics for mobile user identification [11]. This paper describes that integrating keystroke dynamics with accelerometer biometrics improved the model performance from 49.44% to 61.11%.

In 2017, Belen Rıos-Sanchez did a comparative study of Palm print feature extraction methods for contact-less biometrics under different environmental conditions [12]. This paper evaluates different palmprints feature methods like uniqueness, user-friendliness, low cost and non-instructiveness and also evaluate matching approaches in terms of Interest of computation time and accuracy gained.

In 2017 Nobuyuki Nishiuchi did the study on Behavioural Biometrics to Predict User's Interest Level using Web Access Log [13]. This study or research is based on the user's interest level. This paper analyzed interest levels of one category product getting through the interview and the access time during the purchasing process in websites were analyzed. Hence, the value of the user's access log in websites has been improved.

S No	Author and year	Technique	Benefits
1	A. Jain, R. Bolle and S. Pankanti -1999	Networked Society	Use of image processing in network security
2	P. Jonathon Phillips, Hyeonjoon Moon - 2000	Face-Recognition Algorithms	Useful in biometric security
3	Gerhard X. Ritter; Joseph N. Wilson -2001	Computer Vision Algorithms	Various image processing algorithm have been discussed.
4	Kong W. K. and Zahng D.-2001	eyelash detection model	Plays significant role in security implementation
5	W.K. Kong, D. Zhang- 2001	support vector machines	High speed performance
6	L. Ma, and T. Tisse- 2003	Iris Texture Analysis	Security has been enhance
7	L. Masek- 2003	Human Iris Patterns	High level security
8	D. Zhang, Wai-Kin Kong, J. You and Michael Wong,- 2003	Online palm print identification,	Easy to use and implement
9	Z. Duo - 2009	Biometrics	Significance of biometric has been represented
10	Dr.T. Karthikeyan- 2014	Multi-Biometric Personal Authentication	Allows multi biometric security
11	Ralph Joseph DL. Gonzales, Kyle.R.CorpusAlvin Scott Morada -2016	Keystroke Dynamics and Accelerometer Biometrics	Flexible and high speed
12	Belen Rıos-Sanchez, Miguel Viana-Matesanz, Carmen Sanchez-Avila - 2017	Biometrics	Biometric Security has been provided
13	Nobuyuki Nishiuchi ,Seima Aoki- 2017	Biometrics	Biometric Security has been provided

3. Role of image processing in biometrics

A biometric system [7] is used for identifying and verifying the identity of a person on the basis of two characteristics, first is physiological characteristics and other is behavioural characteristics

In biometrics, digital image processing is required for analyzing and verifying a person whose biometric image is already saved in the biometric database. Some examples of image-based biometrics are face recognition, iris-scan, fingerprints and so on.

All the image-based biometrics work in a similar way :

- Firstly, a person submits a sample that is an unprocessed image or a person can record his/her physiological a nd behavioral characteristics via any digital device.
- Then the image-based biometrics is processed to extract the useful or meaningful data from an already saved biometric database which decides that sample is matched or not.

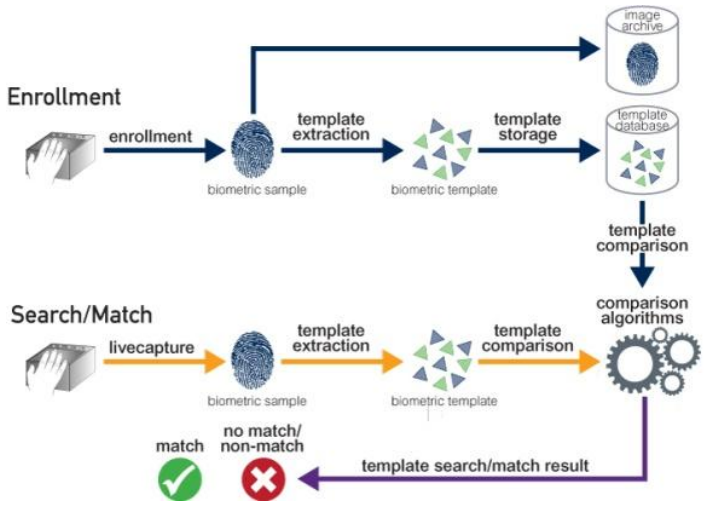

Fig 2 Role of image processing in Biometric [15]

Fig 2 represent how biometric sample is captured and digital image processing function are applied in order to perform image comparison. If the sample is matched the person is authenticated otherwise no match is shown.

The presentation of these systems situated in a transparent manner. Thus the suitable information must always be offered to employees. At the place where the introduction of biometric systems has been considered essential, the employers should opt for this system. It offers a high level of comfort in terms of privacy.

All image-based biometric systems use common main functional components [9], which include:

- **Storage entity** with the biometric data samples (templates) of the enrolled persons that are linked or integrated into a biometric database with the individuality information of the corresponding persons.
- **Biometric sensor device** and pre-processing capacities are used to capture the biometric sample data as input data from a person.
- **Comparison process** helps in evaluating the similarity between the captured data sample of a person and reference and then results in a matching score.
- **The decision function** is a decision function which decides if the data sample matches the reference template or not.

Types of biometrics

Biometrics can be classified into two classes :

1) Physiological biometrics
2) Behavioral biometrics

Physiological biometrics

The physiological biometrics are based on measurements and data derived directly from the human body is used in physiological biometrics. This method mainly used in identifying and verifying individuals. This involves the face recognition, fingerprint recognition, hand geometry, iris recognition and DNA.

Behavioral biometrics

The behavioral biometrics are also based on measurements and data derived from an action is used in behavioral biometrics. This method is mainly used for verifying an individual. This involves keystroke scan, signature as well as voice recognition. Some of them have been discussed below to understand this concept.

Fingerprint Recognition

Fingerprint Recognition [5] refers to the automated technique of identifies and verifies the fingerprints of a person in order to grant or deny access for any physical facility or machine. This technique records the features such as arches, loops, and whorls along with the outlines of edges. It also captures the minutiae along with furrows. Every person has their own unique fingerprints. This recognition has been done

by capturing an image of a person's fingertips and then record the attributes that are discussed before.

Face Recognition

Face recognition system [2] has been considered a kind of biometric computer application. It is capable for identifying or verifying the person using a digital graphics. It has been done to compare and analyze the patterns. Such biometric environment has been applied to secure the systems. Existing facial recognition environments performs with face prints. Such systems are capable to identify the 80 nodal points. These points are situated on the face of the human. Nodal points have no uses. On the other hand, the endpoints are applied to calculate the variables on the face of a person. It involves the nose length and width. It also considers the cheekbone shape as well as the depth of eye socket.

Iris Recognition

Iris recognition [10] is an automated method of biometric authentication and identification. This method takes grand resolution pictures of the iris of a person eye and use mathematical pattern schemess for reading and then for matching his/her iris patterns against the patterns stored in the stored database of biometricss. The iris of a person may be brown, blue, black, grey, or greenish in color whose complex patterns are stable and unique. Behind the cornea, there is colored part of the eye known as the iris. Iris is developed before birth. The appearance of this iris changes very little or never gets changes during an individual's life. A person's left iris is different from right iris and even irises of identical twins are also different. So, this differentiation can make iris-scan a reliable physiological biometric.

Voice Recognition

Voice recognition [11] is also known as speech recognition. It may be hardware device or computer software. Speech recognition is mainly used to perform commands, operate any device, etc. This biometric technique is used to identify, recognize the voice of an individual speaker.

Signature Recognition

Signature recognition [11] can be classified in two different modes; one is static and second is dynamic. Static mode is the conventional and off-line mode in which a user signs their signature on paper and then computerizes it through a camera or an optical scanner, and then the biometric sensor observes the signature captured by the camera by analyzing its shape. Dynamic mode is known as online mode. As the name indicates, users sign their signature in a drawing tablet or on smart-phones, where users can sign using their finger or an appropriate pen. Then the raw data is pre-processed to eliminate false information, to filter the powerful signals and to confirm the acquisition process.

4. Scope of research

The processing of image has been considered faster and cost- effective. Replicating a digital picture is easy, and the picture aspect stays superior unless it is squeezed. A biometric device has been supposed to provide security. These devices are using automated techniques of modifying or recognizing the distinctive of a living soul. It is relying on observable characteristics as well as physical. The biometric technology has been proven helpful in libraries to ensure safety and security to its invaluable collections, infrastructure and human resources.

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