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Chapter One

Literature Review

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1.1 Introduction

Identity management is a critical function in a variety of applications in the field of modern information management technology, making inseparable components from it. One such application is the protection and confidentiality of information, which includes restricting access to data and information at nuclear power plants, airports, and banks, as well as managing logical access to resources related to them in addition to, organizing border crossings to neighboring countries, conducting financial transactions remotely, or social distribution. Social welfare services, web-based services, and decentralized customer service centers (e.g. online banking and credit card services). All the mention applications and many more need highly trusted identity management systems to reduce the risk and mistrust regarding information security, confidentiality, and identity theft.

The process of determining the relationship between individuals and their identities is the primary task of identity management. A person can be identified by identity, to validate their claim. Personal identification is defined as the process of identifying people using one of the three basic methods listed below: First, they have exclusive confidential information (for example, a password, a PIN, or an encryption key), this approach is what the person knows. The second suggests, the exclusive possession of the external token should be through the person who owns the object (e.g., ID card, driver's license, passport, physical key, or personal device such as a mobile phone), and this approach is what the person owns externally. The third approach, who is a core person, can be identified by their inherent physical or behavioral traits and is known as biometric identification or field scanning.

Biometric recognition examines a person's unique physical or behavioral characteristics in a fully automated or semi-automated way to identify the person. There are a variety of reasons, knowledge-based and token-based mechanisms, such as surrogate representations of identity such as passwords or PIN or ID cards, have not been adequate to manage a trusted identity, which cannot be remembered/lost/easily stolen or similar, along with a fraudulent presentation or redundant.

Documents can be also allow the identification of individuals to be concealed. Using identification, or simply biometrics, it is possible to confirm or establish the identity of an individual. Since vital characteristics are inherent in a person, these traits cannot be manipulated, shared, forgotten, and cannot be manipulated. That is users of a biometric system who provide their biometric ID to a system identify it. Figure (1.1) shows some basic methods for identifying people.



Figure (1.1) Some basic approaches for person recognition.[1]

The biometric system extracts features set from the acquired biometrics data, and compares it with the template sets in the data and for many decades it has been and still is an area of extensive research. The biometric traits includes, fingerprint, palmprint, face, iris, retina, ear, voice, signature, gait, hand geometry and the DNA information of an individual to determine or verify his identity etc, All this types describe it and put in the end them [1-12]. as shown in figure (1.2).

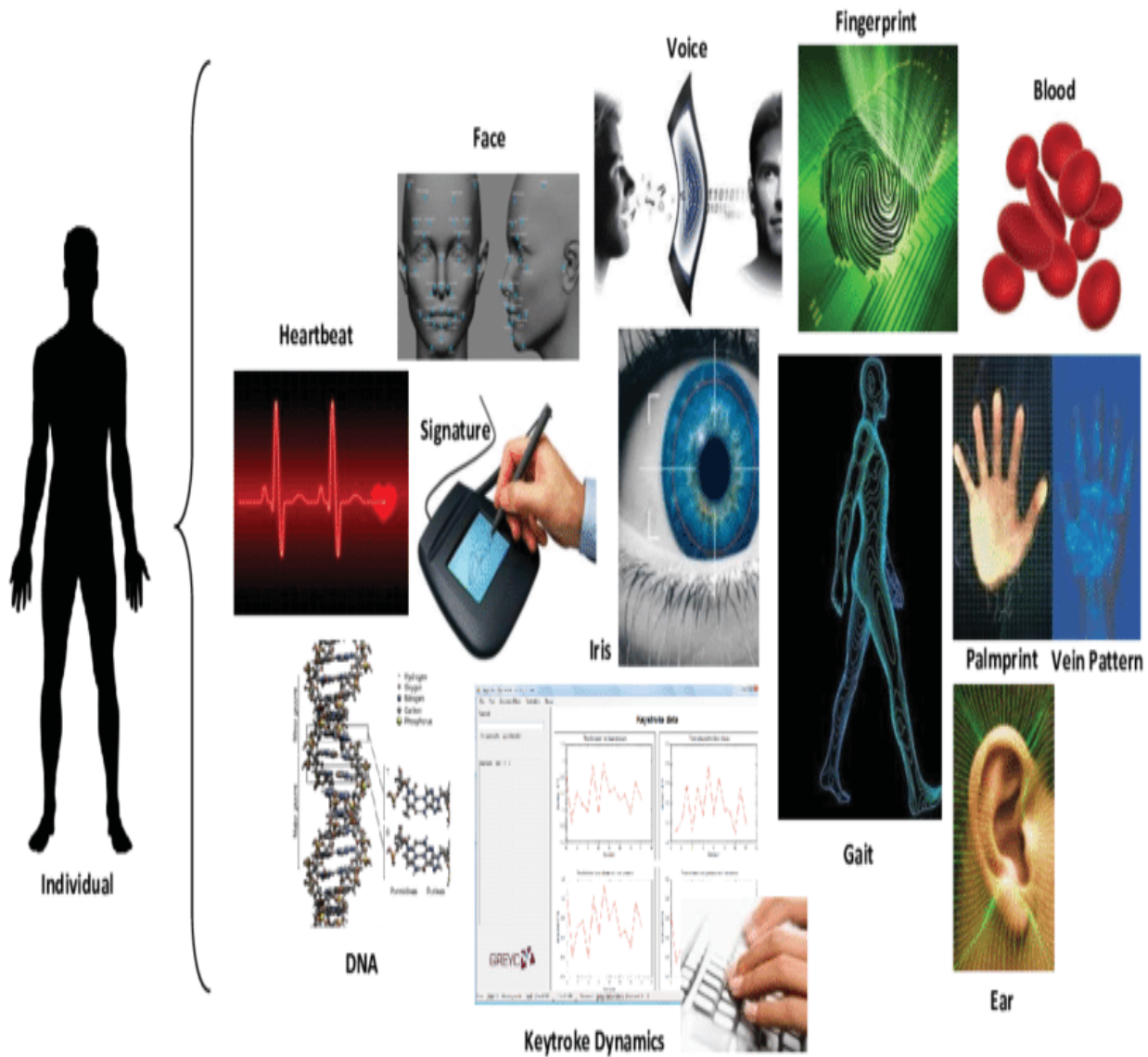


Figure (1.2) Some examples of body traits that have been used for biometric recognition [12].

Cognitive biometrics refers to face recognition, as it has many advantages over other biometric methods, some of which we explain here: Most of these technologies requires the user to work with some voluntary action, i.e. placing a hand on a fingerprint device to take fingerprints or detect The shape of the hand damage to the skin tissue of the hands and fingers (i.e. bruised or cracked) this may led to, to identify the iris or retina, the person must stand in a fixed position in front of the camera .

As for those who suffer from eye diseases such as damage to the retina or iris, this might prevents utilizing in the techniques that depend on it, and resorting to other techniques. In the identification of the iris and retina, these techniques need advanced devices with high technology and very high prices and are very sensitive to any movement of the body. High-noise sound in public places and fluctuations of sound can be recognized on a mobile phone or recorded on tape.

Taking a swipe for signature through an automated scan that can be modified or forged. In the case of capturing biological characteristics, through heavy use the device can become a transmitter of germs and impurities from one user to another this require continuous sanitizing as experienced during Covid-19 pandemic, while faces cannot be recognized properly without any explicit action or user intervention since the face images. Can be obtained easily with two fixed cameras and it is cheap. Facial recognition is one of the most important biometric technologies and has the advantages of high accuracy and low intrusion, and it is important in many real-world applications (for example, access control, Mobil phones, information protection and confidentiality, surveillance, and entertainment, smart cards and human-computer interaction (HCI) communities) [13].

In addition to its usefulness in person recognition, the facial images are a suitable also for revealing other attributes like biographic information (e.g. age, ethnicity, and gender) and emotional state of a person (e.g., happiness or anger).

Face recognition can be defined as the process of establishing the identity of a person based on facial characteristics [13].

In another simple phrase, it's a comparing between two of face images and determining if they are of the same person. The recognition task is a challenging with the face appearance of a person due to many variations between the images of the same face (e.g., age, pose, illumination, and facial expressions as well as exhibit changes in appearance due to make-up, facial hair, or accessories) as shown in figure (1.3).



Figure (1.3) Some examples of face feature [13].

These challenges are accompanied by progress in the field of automatic face recognition; however, facial recognition is still having some problem and the solution to this problem has not been completed correctly until this moment. There is a wide field for researchers to identify the characteristics and features that these images possess and to identify them more through experiments and their comparison with the previous studies.

1.2 History

1. **Z.Ningbo , et al. [72], 2013**, introduced a method to improve the classification accuracy of face recognition, a sparse representation method based on kernel and virtual samples is proposed. The proposed method has the following basic idea: first, it extends the training samples by copying the left side of the original training samples to the right side to form virtual training samples. Then the virtual training samples and the original training samples make up a new training set and we use a kernel-induced distance to determine M nearest neighbors of the test sample from the new training set. Second, it expresses the test sample as a linear combination of the selected M nearest training samples and finally exploits the determined linear combination to perform classification of the test sample

2. **R.Abiantun ,et al. [73], 2014**.Showed that focus on one-to-one matching scenarios where a query face image of a random pose is matched against a set of gallery images. We propose a method that relies on two fundamental components: (a) A 3D modeling step to geometrically correct the viewpoint of the face. For this purpose, we extend a recent technique for efficient synthesis of 3D face models called 3D Generic Elastic Model. (b) A sparse feature extraction step using subspace modeling and ℓ_1 -minimization to induce pose-tolerance in coefficient space. This in return enables the synthesis of an equivalent frontal-looking face, which can be used towards recognition. We show significant performance improvements in verification

rates compared to commercial matchers, and also demonstrate the resilience of the proposed method with respect to degrading input quality. We find that the proposed technique is able to match non-frontal images to other non-frontal images of varying angles.

3. R.Jafri, et al. [15], 2015. proposed Sparse representation based classification (SRC) produces interesting results for robust face recognition by coding a query sample as a sparse linear combination of all training samples and then classifying it by evaluating which class leads to the minimal coding residual.

4. R. Vidal, et al. [9], 2016. Assume we have a data matrix consisting of a low-rank component and a sparse component superimposed. Is it possible to restore each component separately? We show that by solving a relatively straightforward convex program called Principal Component Pursuit, it is possible to recover both the low-rank and sparse components perfectly under some reasonable assumptions; among all viable decompositions, just minimize a weighted mixture of the nuclear and l - norms

5. N.Oliver,et al. [45]2017. Introduced a method the kernel minimum square error classification (KMSEC) algorithm has been widely used in classification problems. It shows a good performance on image data besides the following drawbacks: not sparse in the solutions and sensitive to noises. The latter drawback will result in a decrease in the recognition performance. We propose an improved kernel minimum square error classification algorithm (IKMSEC) by using the $L2,l$ -norm -norm regularization, which can obtain a sparse representation of nonlinear features to guarantee an efficient classification performance. The comprehensive experiments show the promising results in face recognition and image classification.

1.3 Motivations

The researcher was to get each person (the identity of the person) quickly and simply through modern and advanced technologies, but in the past, this goal was difficult. The easiest and simplest feature in people that can be recognized, understood, and cannot be forgotten is the face where natural biometric techniques are can smoothly recognize, In the past researchers used optical technology to identify people, The process of face recognition became important all over the world and the need for automatic face recognition raised.

Recently, studies and some applications have turned to face recognition. Some algorithms are optimized to solve the problem of the effect of a single factor or combination of appearance difference factors for face recognition. For example, some high-end features that work with sensitive lighting conditions have been optimized and tested on a set of data that contains only different lighting. Finally, a database of faces was obtained under controlled settings that contain differences in facial appearance caused by one or more of a combination of factors. The value of these studies is to solve the problem of performing facial recognition and to know the power of the algorithms to collect these databases. It is necessary and important to test every single face algorithm on these standard face databases and even

- Through one or two sources, several differences are created in the appearance of the face, so that the image of the face can be directed, measured and photographed differently.
- There are several differences in the appearance of the face that are separate, for example the positions of the head are directed at a certain angle or from different directions.
- When a person wants and realizes that a picture has been taken of him, he must remain in front of the camera. It is collected collaboratively.

The universal human trait is in the face. The process of face recognition is not only important but because of the potential of many potential applications in the fields of research, and solving classification problems is important and can solve this matter because of the ability such as object recognition.

1.4 Challenges of Face Recognition

Face recognition has attracted a lot of attention in more than three decades and many studies have been carried out for it. But there are still many challenges facing. It the most difficult aspects of face recognition are summarized as follows:

1. There are an enormous number of humans: when identifying similar faces, Different persons may have similar appearance that sometimes it is impossible for a human to identify them, moreover, if they are genetically related (identical twin, father and son, etc.). Such the inter classes similarities further increase the difficulty of face recognition as shown in figures (1.5), (1.6).



Figure 1.4 Some examples identical twin image [15].



Figure 1.5 Some examples similarly son and father [15].

2. **Illumination:** Illumination means light variations. Illumination changes can vary the overall magnitude of light intensity reflected from an object, as well as the pattern of shading and shadows visible in an image. Indeed, varying the illumination can result in larger image differences than varying either the identity or the viewpoint of a face. The same individual imaged with the same camera and seen with nearly the same facial expression and pose may appear dramatically different with changes in the lighting conditions.

The problem of face recognition over changes in illumination is widely recognized to be difficult for humans and for algorithms. The difficulties posed by variable illumination conditions, therefore, remain a significant challenge for automatic face recognition systems. It is found that the difference between two images of the same person taken under varying illumination is greater than the difference between the images of two different persons under same illumination. The variation in illumination changes the appearance of the face drastically as shown in figure (1.7).



Figure (1.6) Some examples Variations in illumination[15].

3. Effect of the external factors on face appearance: When in a Face Recognition System the whole face is not available as input image or image sequence, then it is termed as Occlusion. It is one of the important challenges of the face recognition as shown in the figure (1.8).

This is due to presence of various occluding objects such as glasses, beard, moustache etc. on the face and when an image is captured from a surveillance camera; the face lacks some parts. In real world applications also, it is very common situation to acquire persons talking on the phone or wearing glasses, scarves, hats, etc. or for some reasons having their face covered with hands. Such a problem can severely affect the classification process of the recognition system.



Figure (1.7) Some examples Face occlusion and disguise [16].

4. Effect of the factors of pose, expression and aging on face appearance: The human face is not a unique, rigid object. Everything changes with time, so with the increasing age the appearance of a person also changes which affect the face recognition system, a face appears in many different shapes viewed from different angles in an image. The changes in facial features as a result of aging factors (wrinkles, speckles and sagged cheeks, eyes, or mouth) as shown in figure (1.9).



Figure (1.8) Some examples many different shapes from different angles in an image [17].

المستخلص

يشير التعرف على الوجوه عمومًا إلى فئة من الأساليب التي تحل المشكلات من خلال تمثيل المتغيرات المهمة كمصفوفات ذات رتبة منخفضة. لقد حقق نجاحًا كبيرًا في مختلف المجالات بما في ذلك رؤية الكمبيوتر / واختلافات الإضاءة / واختلافات التعبير الشديدة لوجه / وفساد البكسل العشوائي / ضلال وتمويه والمعلوماتية الحيوية.

في الأونة الأخيرة / تم إحراز تقدم كبير في النظريات والخوارزميات والتطبيقات ذات الرتبة المنخفضة للتعرف على الوجوه ، مثل مصفوفة الرتبة المنخفضة للتعرف على الوجوه المطبقة على التمثيل المتناثر والتمثيل التعاوني. جلبت هذه التطورات المزيد والمزيد من الاهتمام بهذا الموضوع. في هذه الأطروحة نقترح أن نراجع التقدم الأخير في الرتبة المنخفضة للتعرف على الوجوه / وأحدث الخوارزميات / والتطبيقات ذات الصلة في تحليل الصور. نقدم أولاً نظرة عامة على مفهوم الرتبة المنخفضة للتعرف على الوجوه والمشكلات الصعبة في هذا المجال. بعد ذلك ، نلخص النماذج والخوارزميات لمصفوفة الرتبة المنخفضة في التعرف على الوجوه ونوضح مزاياها وقيودها من خلال التجارب العددية. بعد ذلك ، نقدم بعض التطبيقات ذات الرتبة المنخفضة للتعرف على الوجوه في سياق تحليل الصور