

A Survey on Face Recognition System - A Challenge

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Abstract : Face recognition presents a challenging problem in the field of image analysis and computer vision, and as such has received a great deal of attention over the last few years because of its many applications in various domains. This paper focuses on the meaning of face recognition system, human face features that use to identify the face, face recognition types including two- dimensional system (2D) and three-dimensional system(3D)& the explanation of three-dimensional recognition procedures We also explained our new idea for recognizing the human face. This paper is an attempt to give an idea of the state of the art of face recognition technology.

Keywords: Face Recognition, Person Identification, Biometrics, 2D, 3D Technology

1. Introduction

Now a days with the network world, the way for crime is become easier than before. Because of this reason, network security has become one of the biggest concerns facing today's IT departments. We heard a lot about hackers and crackers ways to steal any password or pin code, crimes of ID cards or credit cards fraud or security breaches in any important building and then reach any information or important data from any organization or company. These problems allow us to know the need of strong technology to secure our important data.

This technology is based on a technique called "biometrics". Biometric is a form of bioinformatics that uses biological properties to identify people. Since biometric systems identify a person by biological characteristics, they are difficult to fake. Examples of biometrics are iris scanning, signature authentication, voice recognition and hand geometry.

Face recognition is one example of biometric [1, 2] and it is use the character of the face to identify a person. Face recognition has drawn attention in computer vision at 1970 and the rest time the system of face recognition used was at 2001 for the purpose of reducing the crimes but this system fails to recognize the clear picture of any thief because the thieves were wearing a mask.

Face recognition techniques can be broadly divided into three categories based on the face data acquisition methodology: methods that operate on intensity images; those that deal with video sequences; and those that require other sensory data such as 3D information or infra-red imagery.

1.1 Reason of Choosing Face Recognition System

There is multiple reasons that make us choose Face Recognition System from all the kinds of biometric, These are:

1. It doesn't need any Physical interaction from the user.
2. It is very accurate and more secure.
3. We can use any cameras or image capture device.

Biometric-based techniques have emerged as the most promising option for recognizing individuals in recent years since, instead of authenticating people and granting them access to physical and virtual domains based on passwords, PINs, smart cards, plastic cards, tokens, keys and so forth, these methods examine an individual's physiological and/or behavioral characteristics in order to determine and/or ascertain his identity. Passwords and PINs are hard to remember and can be stolen or guessed; cards, tokens, keys and the like can be misplaced, forgotten or duplicated; magnetic cards can become corrupted and unreadable. However, an individual's biological traits cannot be misplaced, forgotten, stolen or forged. Biometric-based technologies include identification based on physiological characteristics (such as face, fingerprints, finger geometry, hand geometry, hand veins, palm, iris, retina, ear and voice) and behavioral traits (such as gait, signature and keystroke dynamics) [3]

1.2 Applications

Face recognition is used for two primary tasks:

- 1. Verification (one-to-one matching):** When presented with a face image of an unknown individual along with a



claim of identity, ascertaining whether the individual is who he/she claims to be.

2. Identification (one-to-many matching): Given an image of an unknown individual, determining that person's identity by comparing (possibly after encoding) that image with a database of (possibly encoded) images of known individuals.

There are numerous application areas in which face recognition can be exploited for these two purposes, a few of which are outlined below:

- Security (access control to buildings, airports/seaports, ATM machines and border checkpoints [9, 10]; computer/network security [11]; email authentication on multimedia workstations).
- Surveillance (a large number of CCTVs can be monitored to look for known criminals, drug offenders, etc. and authorities can be notified when one is located; for example, this procedure was used at the Super Bowl 2001 game at Tampa, Florida [12]; in another instance, according to a CNN report
 - General identity verification (electoral registration, banking, electronic commerce, identifying newborns, national IDs, passports, drivers' licenses, employee IDs).
 - Criminal justice systems (mug-shot/booking systems, post-event analysis, forensics).
 - Image database investigations (searching image databases of licensed drivers, benefit recipients, missing children, immigrants and police bookings).
 - "Smart Card" applications (in lieu of maintaining a database of facial images, the face-print can be stored in a smart card, bar code or magnetic stripe, authentication of which is performed by matching the live image and the stored template) [13].
 - Multi-media environments with adaptive human-computer interfaces (part of ubiquitous or context-aware systems, behavior monitoring at childcare or old people's centers, recognizing a customer and assessing his needs) [14,15].
 - Video indexing (labeling faces in video) [16, 17].
 - Witness face reconstruction [18].

1.3 Pros & Cons of Face Recognition Technology

Advantages:

Face recognition appears to offer several advantages over other biometric methods, a few of which are outlined here:

a) Almost all these technologies require some voluntary action by the user, i.e., the user needs to place his hand on a hand-rest for fingerprinting or hand geometry detection and has to stand in a fixed position in front of a camera for iris or retina identification. However, face recognition can be done passively without any explicit action or participation on the part of the user since face images can be acquired from a distance by a camera. This is particularly beneficial for security and surveillance purposes.

b) Furthermore, data acquisition in general is fraught with problems for other biometrics: techniques that rely on hands and fingers can be rendered useless if the epidermis tissue is damaged in some way (i.e., bruised or cracked). Iris and retina identification require expensive equipment and are much too sensitive to any body motion. Voice recognition is susceptible to background noises in public places and auditory fluctuations on a phone line or tape recording. Signatures can be modified or forged. However, facial images can be easily obtained with a couple of inexpensive fixed cameras. Good face recognition algorithms and appropriate preprocessing of the images can compensate for noise and slight variations in orientation, scale and illumination.

c) Finally, technologies that require multiple individuals to use the same equipment to capture their biological characteristics potentially expose the user to the transmission of germs and impurities from other users. However, face recognition is totally non-intrusive and does not carry any such health risks.

Disadvantages

The fact that in their most common form (i.e., the frontal view) faces appear to be roughly alike and the differences between them are quite subtle. Consequently, frontal face images form a very dense cluster in image space which makes it virtually impossible for traditional pattern recognition techniques to accurately discriminate among them with a high degree of success [19]. Furthermore, the human face is not a unique, rigid object. Indeed, there are numerous factors that cause the appearance of the face to vary.

The sources of variation in the facial appearance can be categorized into two groups: intrinsic factors and extrinsic ones [20]. A)

a) Intrinsic factors are due purely to the physical nature of the face and are independent of the observer. These factors can be further divided into two classes: intrapersonal and interpersonal [21]. Intrapersonal factors are responsible for varying the facial appearance of the same person, some examples being age, facial expression and facial paraphernalia (facial hair, glasses, cosmetics, etc.). Interpersonal factors, however, are responsible for the differences in the facial appearance of different people, some examples being ethnicity and gender. B)

b) Extrinsic factors cause the appearance of the face to alter via the interaction of light with the face and the observer. These factors include illumination, pose, scale and imaging parameters (e.g., resolution, focus, imaging, noise, etc.). Evaluations of state-of-the-art recognition techniques conducted during the past several years, such as the FERET evaluations [22], FRVT 2000 [23], FRVT 2002 [24] and the FAT 2004 [25], have confirmed that age variations, illumination variations and pose variations are three major problems plaguing current face recognition systems [26].

Although most current face recognition systems work well under constrained conditions (i.e., scenarios in which at least a few of the factors contributing to the variability

between face images are controlled), the performance of most of these systems degrades rapidly when they are put to work under conditions where none of these factors are regulated[27].

2. Face Recognition Technology

2.1 Definition

As we all know that almost the security system in the airports, huge hotel and especially in the police led depend on the use of advanced protection system that based on the computer programs. These program verifying people present and also thieves. This system is based database for pictures of people criminals, thieves and others with picture captured by a surveillance camera. So a facial recognition system is a computer application for automatically identifying a person digital image that its source is already sorted in the database. Actually, it is works by comparing the selected facial features from the image and a facial database.

2.2 Face Measure

Every human face has many distinctive features are in a various meandering on the face. The program is based on these parameters nodal points. Each face has approximately 80 nodal points. Almost facial recognition programs analyze the relative position, size, and/or shape of the eyes, nose, cheek boons and jaw. The most famous features of the face measured by a program are:

1. The distance between the eyes.
2. The depth of the eye.
3. Nasal breadth.
4. The form of the cheek boon.
5. Along the jaw line.

The parameters measured by the program and then translated into digital codes called the fingerprint and face print used to represent the face in the database.

2.3 Face Recognition Types

2D System In the past [4], facial recognition programs depended on two dimension (2D) picture to compare it with the image sorted in the data base, but these programs did not succeed only if the person is looking just to the camera. Of course anyone suspect will be warned that he/she will see a camera in place, and here lies the problem where this fails by depending on the 2D system. Beside, the additional changes in the environment surrounding the person, such as light will produce images the computer cannot have in the corresponding memory, also the changes in the same person can cause a system failure in face recognition [5, 6].

3D System Modern system for face recognition based on the pattern of three-dimensional (3D) [8], where the special cameras will captured images of three-dimensional views of the suspected person, and using the special main features of each face that are not changed significantly

with time , such as eye hole, the distance between the eyes, nose shape and others mentioned above. These features are a source of information for a facial recognition system as the changes in the lighting or surrounding environmental conditions do not affect these measurements, for example: can operate these systems in any lighting conditions even if the place was dark and even if the person is not in the face of camera.

2.4 3D Face Recognition

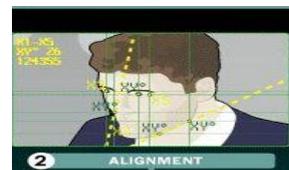
How 3D Procedure Work: The use of depth and focus of the face that does not affect the change in lighting is known as *three-dimensional face recognition system*. The software system that relay on three-dimensional technique with a series of steps to eventually be able to perform a face recognition procedure. We can divide the whole process by the following steps. Steps involve in the face recognition system are: (fig 1)

Fig. 1 the steps of 3D face recognition system.

- 1) **Detection:** Capture a digital image by a two dimensional digital camera or even using a video camera.



- 2) **Alignment:** After capturing the image, the system will determine a head position, size and its direction.

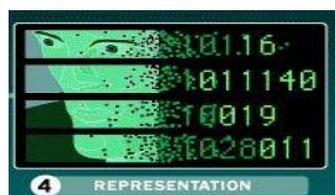


- 3) **Measurement:** The software (specific program) will calculate the curves and meanders on the face to an accuracy of part OS the millimeter. Then the program ready to convert that information to establish a face model or pattern.





4) Representation: In this step, the system will translate the model and form a specific code. The code for each model is unique and consists of a set of numbers.



5) Matching: In the case that the picture is three-dimensional and corresponding to the three-dimensional images that stored in the database, the comparisons between the images are immediately. But the challenge facing these systems is that most of the images stored in database are in two-dimensional.



The development of a new technology support the use of three different points to get to know any face sorted in database. Some of these points are outside of the eyes, inside the eyes and the tip of the nose. The conduct of the system will carry out these measurements on the dimensions between these points of three-dimensional picture and begin to be converted to two-dimensional images through the application of complex mathematical algorithms. After the conversion process, of this part, the system begins to work of comparison.

6) Verification or Identification: In the step of recognition, the program will compared the images and match them with pictures of the database sorted by the system in the Previous step. But if the goal is verify the result of the previous step, the system compares the image with all images in the database and then matching results are displayed in percentages [3].



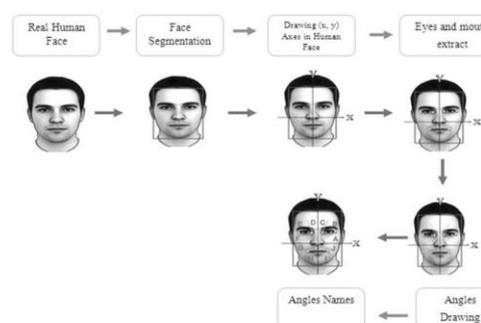
2.5 New Idea for recognize the face

Feature Extraction For face recognition there are several steps as mention before used to recognize the person face. The first step is to divide the human face into some region to reduce the search region for detection purpose. Figure 2 below show the overall feature extraction process.

Face Segmentation mentioned before is the first step in face recognition system is detecting the face and locate the

face area from a given facial scan. The segmented face area starts from the forehead until the chin as shown in figure 2. The subsequent feature point extraction is conducted within the segmented face area.

Fig. 2 Feature Extraction Process



3. Conclusion

As you can see, face recognition system is very important in our daily life. It is possesses a really great advantage. Among the whole types of biometric, face recognition system is the most accurate. Research has been conducted vigorously in this area for the past four decades or so, and though huge progress has been made, encouraging results have been obtained and current face recognition systems have reached a certain degree of maturity when operating under constrained conditions; however, they are far from achieving the ideal of being able to perform adequately in all the various situations that are commonly encountered by applications utilizing these techniques in practical life. The ultimate goal of researchers in this area is to enable computers to emulate the human vision system . To attain this objective, "Strong and coordinated effort between the computer vision, signal processing, and psychophysics and neurosciences communities is needed" As a future work, we would like to explore this research area more deeply.

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