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Facial Recognition-Front and Side View Orientations: Current Situation and Issues

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***Abstract*: Facial recognition is a biometric mechanism, widely used with various advantages. Recently, many applications including vigilance systems, smart houses, or any application which deals with identifying people from images or video feeds, uses facial recognition as primary biometric system. Especially in any meshed/crowded environment (such as any area like Airports, Railway stations etc.), it's challenging to detect and identify faces because of variation in luminance, different expression, or variation in pose. One way to do this, is by comparing the chosen facial features from the image and a facial database. It is basically used in security systems and can be utilized to other biometrics such as body prints (E.g. Aadhar or eye retina recognition systems). In today world, it's a major issue of intrusion in every sector on the basis of security. Most of the times, Intruders are left over without getting any punishment because they can't be identified clearly. Today Facial Recognition is a necessity in the field of Security (i.e. either online or off-line both). Current situation of facial recognition is that, a face can be recognized at condition (>15 frames/sec).**

***Keywords*: facial recognition**

1. Introduction

Facial Recognition [2] is a technology that is capable of detecting and recognizing human face from any feeded input to the software or application from any Digital Images or frames from Video footage. There are various methods in which facial recognition systems work, but in general, they work by comparing selected facial features from given image with faces within a database. It is also described as a Biometric Artificial Intelligence [3] based application that can uniquely identify a person by analyzing patterns based on the person's facial textures and shape. As a computer application, it has been widely used on mobile platforms and also in other forms of technologies, such as securities, robotics and research purposes. It is used to authenticate and to get access in security systems that authenticate the stranger and also compared to other biometrics such as fingerprint or eye retina and iris recognition systems. Although the accuracy of facial recognition system is lower than iris/retina recognition and fingerprint recognition, it is widely utilized due to its contact-less and non-invasive process. Recently, it has also become popular as identification and marketing tool commercially. Other applications include advance user-system interaction, vigilance, video surveillance, automated synchronization (indexing) of images and video database, among others. Facial recognition algorithms can be divided into two approaches, Geometric, that looks at variable features, and Photometric, which is statistical approach that distinguishes an image into different values (such as threshold value and luminance) and compares the values with existing templates to remove variations. Few researchers classify the existing algorithms into two broad categories that is holistic and feature-based models. The Holistic model attempts to recognize the face in its entirety while the feature-based models, subdivide into components such as face-prints, features and analyze every feature and its spatial location with respect to other existing features [4].

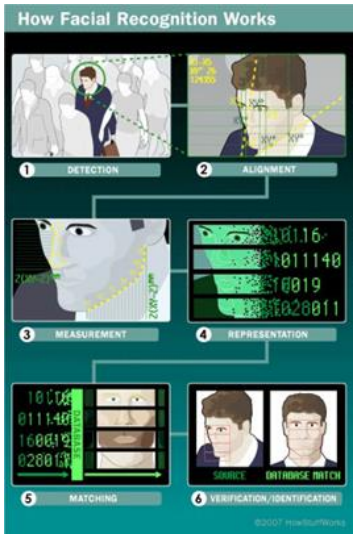

Fig. 1. Working of face recognition

Popular recognition algorithms include principal component analysis using eigen faces, linear discriminant analysis, elastic bunch graph matching using the Fisher face algorithm, the hidden Markov model, the multi linear subspace learning using tensor representation, and dynamic link matching using CNN (Convolution Neural Network). This recognition problem is made difficult by the great variability in luminance, head tilt & rotation, threshold value of lighting intensity and angle, facial expression, aging, etc. Various other attempts in facial recognition by system, have allowed for almost no variability in these quantities. The method of pattern matching

(correlation) of unprocessed visualized optical data, which is somehow used by some research scholar's, fails in cases where the variability is higher or not tolerable. In particular cases, the correlation is very low between two pictures of the same person with two different head rotations. This picture is a short visual description to visualize the working of a Facial Recognition System.

2. Techniques for face detection and recognition

The process of facial recognition is performed into two steps. The first is all about feature extraction, warping & selection and, the second leads to classification of objects [5]. Further, developments upcoming with varying technologies to the existing procedures. Some of the techniques of facial recognition that is mostly used, are as follows:

A. Traditional method of facial recognition

Traditional method of facial recognition involves facial features and landmarks extraction that can easily help in identifying the input face image or video frame from any video input. For example: an algorithm analyzes the relative position, size, and shape of the eyes, nose, cheekbones, and jaw-lines [6]. These features create a face print and then used to search for images with matching features [7].

B. 3-D Facial Recognition

3-D Sensors are used in 3-D facial recognition method, to capture the three-dimensional view of the face (head) map using 3-D Geometry of head formation as shown in Fig. 2.

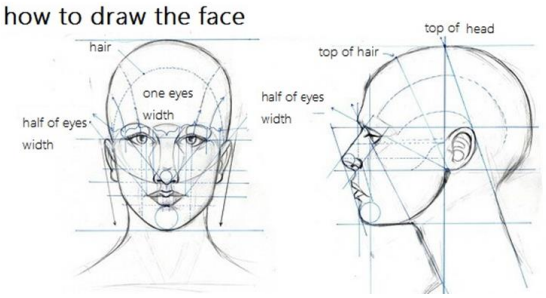

Fig. 2. Three-dimensional head geometry

C. Skin texture analysis

This method uses visual details of the skin (such as Luminance, Threshold), as captured in standard digital or scanned images. This technique, called Skin Texture Analysis, turns the unique lines, patterns, and spots apparent in a person's skin into a mathematical space [8]. Surface Texture Analysis, also works in same way as facial recognition does. A part of skin is taken as a picture, called Face Skin Print. Further that patch is partitioned or breaked into smaller blocks. Various algorithms are taken into action to turn the face skin print into a mathematical and measurable form, then the system distinguishes any lines, pores and also the actual skin texture. It can identify the difference between identical twins, which is not possible by using only facial recognition software [9]. [Fig. 3]

Test results have shown that the including skin texture analysis method, performance in facial recognition increases 20 to 25 percent [10].

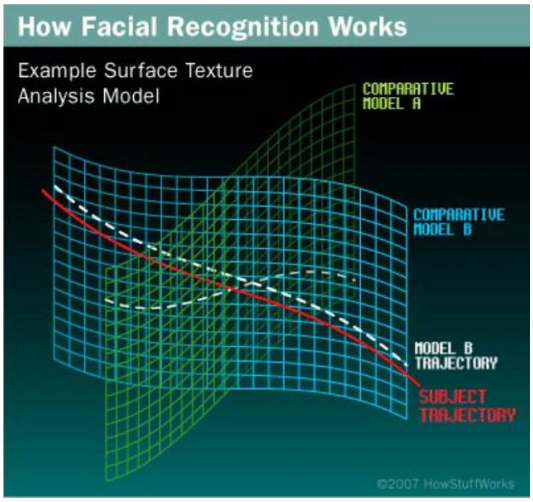

Fig. 3. Modal of surface texture analysis [1]

D. Different combined techniques

Combined techniques have advantage over other systems. It is insensitive to changes in facial expression, including blinking of eyes, frowned face or smiling face relatively to other techniques and has the ability to overcome and analysis for growth of mustache or beard and the appearance of glasses [11].

E. Side-view facial recognition

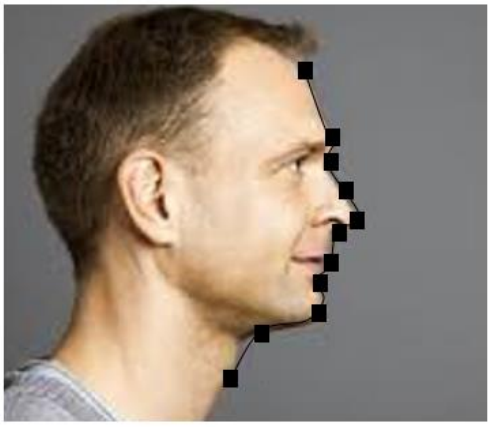

Fig. 4. Manually face warping using landmarks

Front facial recognition is quite easy as compared to side-view facial recognition because in frontal orientation, we have various facial features (such as eyes, lips, nose etc.), which can be utilized as key points to identify the faces. These features are feeded into various algorithms to extract the face from the input image. Algorithms works on the features and calculate various distances (such as eye-to-eye, eye-to-nose, eye-to-lips etc.). But when we get an input image which has Side-view orientation, then there is only limited methods with high complexity. As in Side-Orientation we have very few facial features as compared to Frontal orientation. Here we approach to this problem with

different aspect by calculating the threshold values of pixels. This threshold value helps in extracting the face from background Now, different algorithms are applied the extracted face, which inbounds the face by creating landmarks according to threshold value. This whole phenomenon is called Face Warping.

Discrete Wavelet Transform (DWT) method can also be used to identify the Side-View faced Image. Also, by recreating the LBP (Local Binary Point) according to input image, image can be recognized.

F. Comparison of facial recognition with other biometric systems

The main advantage of facial recognition system is the ability to identification of mass human faces as it doesn't require the involvement or support of the test subject into work. Properly designed systems that are already installed at airports, malls & multiplexes, and other public places are able identify an individual among the crowd, without acknowledging the passer about the system [14]. Comparing to other biometric techniques, facial recognition is not most reliable and efficient. Quality measure is very important in face recognition system as large variations in facial features are possible in image of faces. Various factors such as luminance, facial expressions, pose and noises during face capture affects the accuracy of the facial recognition system. Among all present biometrics systems, facial recognition system has the highest false acceptance and rejection rates [12], thus questions have been raised on the effectiveness of face recognition software in cases of railway and airport security.

3. Conclusion

This paper presented the overview of facial recognition with front and side view orientations focusing on current situation and issues.

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