# A SURVEY ON FACE DETECTION

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**Abstract- Face detection is one of the challenging problems in the image processing. Interest and research activities in face recognition have increased significantly over the past few years. In recent technology the popularity and demand of image processing is increasing due to its immense number of application in various fields. Most of these are related to biometric science like face recognitions, fingerprint recognition, iris scan, and speech recognition. Among them face detection is a very powerful tool for video surveillance, human computer interface, face recognition, and image database management [1]. The goal of this paper is to present a survey on human face recognition. It also point out scope and challenges in designing of Face Image Retrieval Systems.**

**Index Terms- Face recognition, Face detection, Face Image Retrieval and pattern recognition**

## I. INTRODUCTION

Face recognition is becoming an active research area spanning several disciplines such as image processing, pattern recognition, computer vision, neural networks, cognitive science, neuroscience, psychology and physiology. It is a dedicated process, not merely an application of the general object recognition process. It is also the representation of the most splendid capacities of human vision [2].

One of the fundamental techniques that enables such natural human-computer interaction is face detection. Face detection is the step stone to all facial analysis algorithms, including face alignment, face modeling, face relighting, face recognition, face verification/ authentication, head pose tracking, facial expression tracking/recognition, gender/age recognition, and many more. Only when computers can understand face well will they begin to truly understand people's thoughts and intentions [3].

More precisely, face detection is a method by which can point out the region where the face is locating. Now, the concept can be implemented in various ways but mainly use two steps for this implementation. In the first step, localize the face region that means anticipating those parts of an image where a face may present. And in the second step actually verify whether the anticipated parts are actually carrying out a face or not [4].

The Challenges associated with Face Detection can be attributed to the following factors: Pose, Expression, illuminations. In this paper it provides a critical review of the most recent development in face recognition.

The rest of this paper is organized as follows. Section 2 gives Related Work on Face Detection. Section 3 gives inferences Made. Section 4 Challenges of Face Detection. Section 5 gives Applications of Face Detection. Section 6 sets out our conclusion.

## II. RELATED WORKS

In this section it will present some work done by other researchers related to the problem of face detection. This kind of literature survey will give us a good insight into the problem and overviews the different algorithms used to solve the problem. In the early 70's face detection techniques were very simple because the face is in a passport like photo with uniform background and uniform lightning condition. Most of the detection methods consider frontal faces as their research domain. In early 90's more in-depth research was taking over into the problem using different algorithms [5]. These types of detection methods can be categorized into two types: feature based and view based or image based [6].

It classifies different types of face detection techniques as shown in Figure 1.

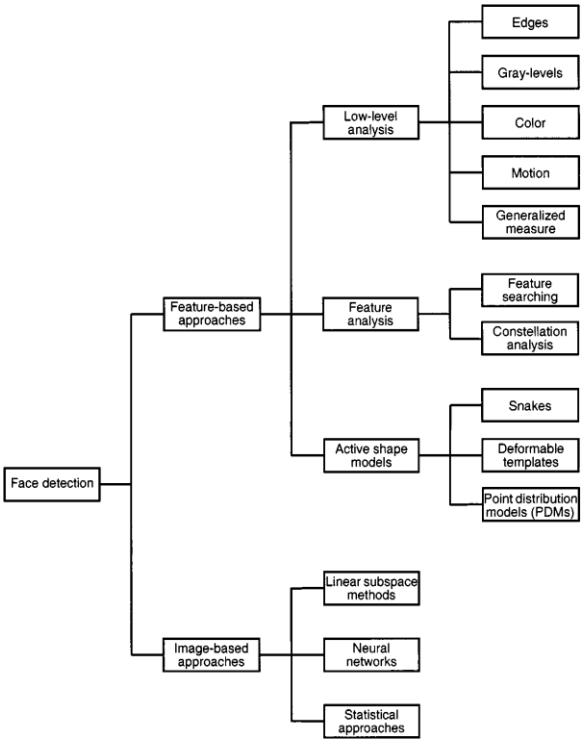


Figure 1. Different Types of Face Detection in [8]

**A. Feature Based Face detection technique: -**

It tries to extract features of the image and match it against the knowledge of the face features. Here the images are first passed into preprocessing filter like simple histograms then the information of the facial features like: the eye brows are darker than the surrounded areas the same concept can be applied to eyes, nose, and mouth [6].

Furthermore this method is sub-categorized into three areas, which are low level analysis, feature analysis and active shape models. Some methods that fall into each category are edge based, skin color based, gray level based and motion based, which are the type of low level analysis, feature searching and constellation are the type feature analysis and lastly snakes, point distribution model and deformable template are the type active shape model [7].

Visual features such as edges, color, and motion are derived in the early stage of the human visual system, shown by the various visual response patterns in our inner retina [14, 15]. This pre-attentive processing allows visual information to be organized in various bases prior to high-level visual activities in the brain. Based on this observation, Reisfeld et al. [13] proposed that machine vision systems should begin with pre-attentive low-level computation of generalized image properties. An example of Feature Based faces detection as shown in Figure 2.

Figure 2. Original image and M¾ of original image Reisfeld et al. [13]

**B. View based or image based face detection Technique:-**

Feature based methods depend on the prior knowledge of the face geometry. Here prior knowledge of the face geometry means relative distance between various facial features, which becomes more troublesome as the background scenery gets more complicated.

On the other hand view based methods [7] were introduced in an attempt to detect the human face without depending on the knowledge of its geometry. View-based methods treat the face detection problem as a pattern recognition problem by having two separate classes, faces and non faces. Some well known algorithms based on this approach include PCA (Principal Component Analysis), Neural Networks, SVM (Support Vector Machines) and other statistical methods. View based techniques include neural networks, linear subspace methods like Eigen faces and statistical approaches like support vector machines (SVM), principal component analysis (PCA). An example of View based or image based face detection technique as shown in Figure 3.

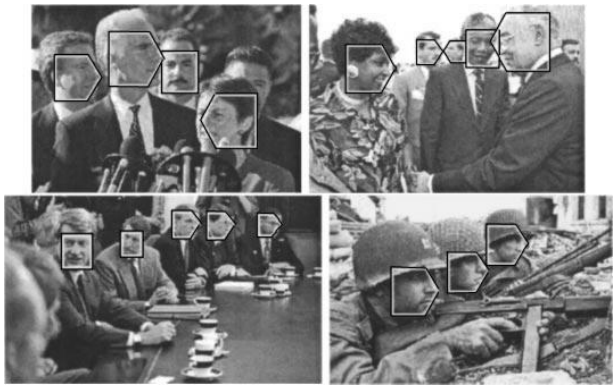

Figure .3. Face detection examples from Schneiderman and Kanade [16] (°c 2000/2001 IEEE).

## III. INFERENCES

- Some of the best algorithms are still too computationally expensive to be applicable for real-time processing, but this is likely to change

with coming improvements in computer hardware.

- Multi-resolution window scanning can be avoided by combining the image-based approach with a feature based method as a preprocessor with the purpose of guiding the search based on visual clues such as skin color.
- The most important application for face detection is still as a preprocessor in face recognition systems. For offline processing, face detection technology has reached a point where the detection of a single face in an image with fair resolution (typical for a face recognition system) is close to being a solved problem. However, accurate detection of facial features such as the corners of the eyes and mouth is more difficult, and this is still a hard problem to solve. Face detection has also found its way to CBIR systems such as Web search engines and digital video indexing [8].
- The human face is a dynamic object but with a standard configuration of facial features which can vary within a limited range. It is a difficult problem to detect such dynamic objects and considering the changes in faces over time (facial hair, glasses, wrinkles, skin color, bruises) together with variations in pose, developing a robust face detection algorithm is still a hard problem to solve in computer vision systems [8].

## IV. CHALLENGES OF FACE DETECTION

Evaluations of state-of-the-art recognition techniques conducted during the past several years, such as the FERET evaluations [17, 18], FRVT 2000 [19], FRVT 2002 [20] and the FAT 2004 [21], have confirmed that age variations, illumination variations and pose variations are three major problems plaguing current face recognition systems [22].

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 [23].

## V. APPLICATION

Face detection technology can be useful and necessary in a wide range of applications, including biometric identification, video conferencing, indexing of image and video databases, and intelligent human–computer interfaces.

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 [24, 25]; computer/ network security [26]; 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 [27]; in another instance, according to a CNN report, two cameras linked to state and national databases of sex offenders, missing children and alleged abductors have been installed recently at Royal Palm Middle School in Phoenix, Arizona [28]).
- 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) [29].
- 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) [30, 31].
- Video indexing (labeling faces in video) [32, 33].
- Witness faces reconstruction [34].

In addition to these applications, the underlying techniques in the current face recognition technology have also been modified and used for related applications such as gender classification [35-37], expression recognition [38, 39] and facial feature recognition and tracking [40]; each of these has its utility in various domains: for instance, expression recognition can be utilized in the field of medicine for intensive care monitoring [41] while facial feature recognition and detection can be exploited for tracking a vehicle driver's eyes and thus monitoring his fatigue [42], as well as for stress detection [43]. Face recognition is also being used in conjunction with other biometrics such as speech, iris, fingerprint, ear and gait recognition in order to enhance the recognition performance of these methods [30, 43-55].

## VI. CONCULSION

Face recognition is a challenging problem in the field of image analysis and computer vision that has received a great deal of attention over the last few years because of its many applications in various domains. Research has been conducted vigorously in this area for the past four decades. Face detection is a necessary first-step in face recognition systems, with the purpose of localizing and extracting the face region from the background. This paper reviewed the Face Detection while highlighting the past and current technical achievements. Many research issues are highlighted and directions for future solution to cope with these problems are suggested. The ultimate goal of researchers in this area is to enable computers to emulate the human vision system and, as has been aptly pointed out by Torres [56], "Strong and coordinated effort between the computer vision, signal processing, and psychophysics and neurosciences communities is needed" to attain this objective.

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