FACE DETECTION: A SCIENCE OF DETECTING AND RECOGNIZING HUMAN FACE

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Abstract: With the marvelous increase in videotape and image databases, there's an inconceivable need for automatic understanding and examination of information by intelligent systems as it's getting to be plainly distant. Face plays an important part in social intercourse for conveying the identity and passions of a person. mortal beings do haven't a tremendous capability to identify different faces than machines. So, automatic face discovery system plays a significant part in face recognition, facial expression recognition, head- disguise estimation, and mortal – computer commerce etc. Face discovery is a computer technology that determines the position, and size of mortal face in a digital image. Face discovery has been a name among motifs in computer vision literature. This paper represents a comprehensive check of different ways explored for face discovery in digital images. Different challenges and operations of face discovery are also introduced in this paper.

Keywords: Face Detection, Face Recognition, knowledge-based, feature-based, template-based, appearance-based, image, resolution, noise, occlusion.

I. INTRODUCTION

Face detection is gaining attention as an important [2][3] research area with many applications. The applications are video conferencing, human-computer interaction, content-based image retrieval, automatic authorization etc.

Face detection difficulty can be stated as, determining whether there are human faces in the photograph and if there are, returning the location of each face in the image, regardless of its position and lighting condition.

During recent years, face detection has attracted much attention. It has several applications in computer vision communication and regular access control system. Face detection is an elementary yet important step towards automatic face recognition. However, face detection is not clear-cut because it has lots of variations of photograph look, such as pose variation, occlusion, image orientation, illuminating situation and facial appearance.

Face detection is the medium of all facial analysis, e.g., face
localization, facial feature detection, face recognition, face verification and facial expression recognition. Moreover, it is a foundational technique for other applications such as content-based image retrieval, video conferencing, and intelligent human-computer interaction (HCI).

The goal of face detection is to find out whether or not there are any faces in the picture, if present, return the location and the extent of each face. While face detection is a trivial task for human vision, but it is a challenge for computer vision due to the variations in scale, area, orientation, pose, facial expression, light condition, and various appearance features.

II. FACE DETECTION VS FACE RECOGNITION

Even though expressions face detection and face recognition are often used together, facial recognition is only one use for face detection. Facial recognition is used for unlocking phones and mobile apps and also for Biometric verification. The banking, retail and transportation security industries make use of facial recognition to reduce crime and prevent violence.
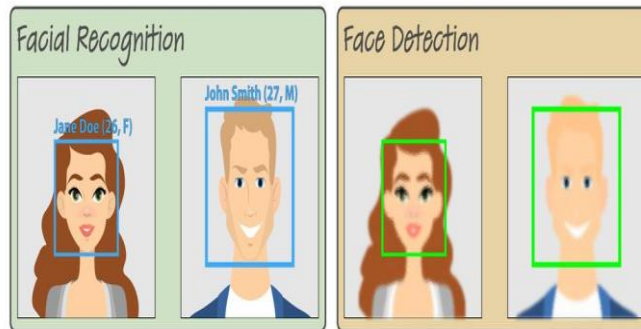
Fig 1: Face Recognition Vs Face Detection

In short, face recognition stretch beyond detecting the presence of a human face to find out whose face it is. The process uses computer applications that capture a digital image of an individual's face -- sometimes taken from a video frame -- and compare it to images in a database of stored records.[4]

III. CHALLENGES FACED

1. Pose variation

Variations in pose cause significant problems in detecting a face. Pose variation can be due to a change in the observing angle of the observer and also due to rotation in the head position. These variations can cause a serious problem in identifying the input image

2. Variations in illumination

The contrast of illuminations could reduce the efficiency of FRS. For moderate levels of lighting in the background, face detection and recognition are much more difficult to perform. Variations in illumination can vary the total magnitude of light intensity being reflected back from an item. On the other hand, higher light levels could lead to over-exposure of the face and (partially) undetectable facial patterns. [10]

3. Variations in expression

Some variation in the facial images can be caused due to differences in expression influenced by the individual's state of emotion. Therefore, it is crucial to understand different facial expressions for evaluating the emotional state. Human expressions consist of macro-expressions such as disgust, anger, happiness, fear, sadness or surprise, and more involuntary, rapid facial patterns. These facial changes can be
computed with the help of dense optical flow. Cosmetics and hairstyles can also be included in this challenge as changing hairstyles and putting on make-up can also cause variation in facial expression.

4. Ageing

Another reason for the changes in the appearance of the face could be the ageing of the human face which could influence the entire procedure of face recognition; if the time between each picture capture is large, there will be notable changes in the person. As per various studies conducted by scientists, every 10 years, there will be significant changes in an individual's facial appearance

5. Occlusions

Variation in facial appearance can also be caused due to the presence of objects such as blockages that partially cover the face. This makes it a difficult task for the system to classify the photograph. Although the face is found, it may be difficult to perceive it due to some hidden facial parts, making it difficult to perceive features. This challenge can be seen in real-world applications where acquiring persons talking on the phone, wearing glasses, hats etc, having their faces covered with hands.

6.   Similar Faces

This is usually a not-so-common challenge. But even humans find it difficult to identify people with similar faces. Hence we can imagine the difficult situation for computers to identify similar face individuals. [8] Especially identical twins with similar facial features, shapes etc. this becomes a difficult task for the face recognition system to identify the individual. This will cause an increase in the false recognition rate as well.

7.   Image Resolution

Another important issue with the face recognition system is the varying quality and resolution of the images given as input. Several factors can influence the resolution of a photograph. The environment, the performance quality of the procuring system and many other reasons can be mentioned as components that are responsible for the varying resolution of the image. If the resolution is good, then the recognition procedure will be much simple and more efficient. So it can be said that resolution is directly proportional to the efficiency of the face recognition system.[6]

IV. TECHNIQUES USED

The strategies used in face detection can be knowledge-based, feature-based, template matching or appearance-based.
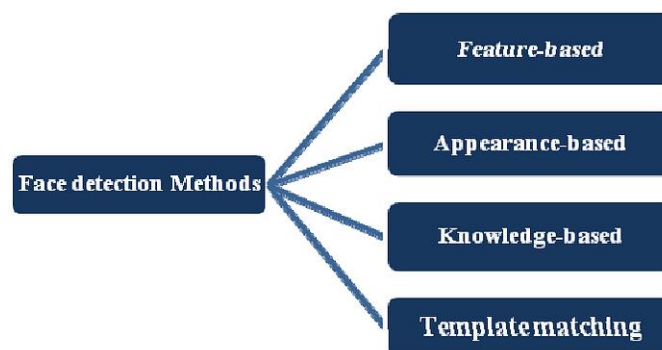

Fig 2: Techniques used for face detection

Knowledge-based, or rule-based strategy, describes a face based on rules. The difficulty of this approach is the importance of coming up with well-defined rules.[9]

Feature invariant methods which use factors such as a person's eyes or nose to detect a face can be negatively influenced by noise and light.

Template-matching procedures are based on comparing images with standard face patterns that have been stored previously and correlating the two to detect a face. Unfortunately, these methods do not address differences in the pose, scale and shape.

Appearance-based methods use statistical analysis and machine learning to find the appropriate characteristics of face images. This procedure is also used in feature extraction for face recognition and is divided into sub-methods.

Some of the more common procedures used in face detection include:

Removing the background. For example, if an image has a plain, mono-color background or a pre-defined, static background, then removing the background can help reveal the face boundaries.

In color images, sometimes skin colour can be used to find faces; however, this may not work with all complexions.

Using motion to find faces is another option. In real-time video, a face is almost moving, so users of this method must calculate the moving area. One disadvantage of this approach is the risk of confusion with other items moving in the background.

A combination of these strategies can provide a powerful face detection method.[4]

V. APPLICATIONS OF FACE DETECTION

In this study the ethical and social issues in the field of information technology are discussed. According to the students' opinion, antireligious propaganda had the highest prevalence in cyberspace among the indices that With Informing people, teaching religious issues, more monitoring and determines the correct rules it can be reduced.

Also hacking was also ranked in the last place. It can be concluded that ethics in information technology can be trained. Therefore, mandatory syllabus for students in bachelors and master and PhD course on ethical issues in information technology seems essential to cope with the ethical challenges of IT.

S.No	Areas	Task Performed
1.	Security and Surveillance	• Airport • ATM Machines • Border Cross point • Network security
2.	Indexing of Videos	• Surveillance • Mugshot/ ticket booking • Criminal Justice system
3.	Investigation of Image database	• To find the Missing Children's • Witness face reconstruction • To Manage the driving license
4.	Verification for identity	• Banking field • Electronic Commerce

Fig 3: Applications of Face detection

Finally, a set of strategies and training for controlling unethical activities in the field of information technology was presented with the hope that their challenges are reduced.

As noted earlier, this study has studied public awareness of some ethical issues in information technology among students, but the age related issues have not been addressed.

Further research can consider on cultural differences, the gender based conditions, intellectual property rights and also user privacy behaviors in social network.
[1][4]

VI. ADVANTAGES AND DISADVANTAGES OF FACE DETECTION

Face detection can be applied to facial motion capture.

Face detection can be used to auto-focus cameras or to count how many people have entered an area. This technology also has marketing applications.[7]

Another application for face detection is part of a software implementation of emotional inference, which can be used to help people with autism understand the feelings of people around them. The program "reads" the emotions on a face using advanced image processing.

The additional use of this is drawing language inferences from visual cues. This can help computers tell who is speaking, which may be useful in security applications. [4]

VII. CONCLUSION

Authentication & Identification has become a major issue in today's digital world. Face detection plays a significant role in authentication & identification. There are several existing approaches available to do so. In this paper, several methods are explained, analyzed & compared. From theoretical analysis & comparison and focusing on the key parameters, like feature extraction face detection way is found to be a very good candidate for face detection.

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