**Human Surveillance History**

**Overview:**

Face detection is a computer technology that determines the location and size of a human face in a digital image. Face detection has been a standout amongst topics in computer vision literature. This paper presents a comprehensive survey of various techniques explored for face detection in digital images. Different challenges and applications of face detection are also presented in this paper. At the end, different standard databases for face detection are also given with their features. Furthermore, we organize special discussions on the practical aspects towards the development of a robust face detection system and conclude this paper with several promising directions for future research.

• Odd expressions Human face in an image may have odd expressions unlike normal, which is a challenge for face detection.

• Face occlusion is hiding face by any object. It may be glasses, scarf, hand, hairs, hats and any other object etc. It also reduces the face detection rate.

• Illuminations Lighting effects may not be uniform in the image. Some parts of the image may have very high illumination and others may have very low illumination.

• Complex background means a lot of objects present in the image, which reduces the accuracy and rate of face detection.

• Too many faces in the image means the image contains too many human faces, which is a challenge for face detection.

• Less resolution Resolution of image may be very poor, which is also challenging for face detection.

• Skin color Skin-color changes with geographical locations. Skin color of Chinese is differ ent from African and skin-color of African is different from American and so on. Changing skin-color is also challenging for face detection.

• Distance Too much distance between camera and human face may reduce the detection rate of human faces in image.

• Face orientation is the pose of the face with an angle. It also reduces the accuracy and detection rate of face detection.

• Gender classification Gender information can be found from human image.

• Document control and access control Control can be imposed to document access with a face identification system.

• Human computer interaction system It is design and use of computer technology, focusing particularly on the interfaces between users and computers.

• Biometric attendance It is a system of taking attendance of people by their fingerprints or face etc.

• Photography Some recent digital cameras use face detection for autofocus. Face detection is also useful for selecting regions of interest in photo slideshows.

• Facial feature extraction Facial features like nose, eyes, mouth, skin-color etc. can be extracted from image.

• Face recognition : A facial recognition system is a process of identifying or verifying a person from a digital image or a video frame. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems.

• Marketing Face detection is gaining the interest of marketers. A webcam can be integrated into a television and detect any face that walks by. The system then calculates the face, gender, and age range of the face. Once the information is collected, a series of advertisements can be played that is specific towards the detected face/gender/age.

**Technique:**

**•Feature based approach**

**•Image based approach**

**Feature based approach:**

Find invariant features of faces for detection. The underlying assumption is based on the observation that humans can effortlessly detect faces and objects in different poses and lighting conditions, so there must exist properties or features which are invariant over these variabilities. Facial features such as skin-color are commonly extracted using edge detectors. Based on the extracted features, a statistical model is built to describe their relationships and to verify the existence of a face.

**Examples:**  skin color, motion, edge etc.

**Algorithm:** YOLOv7

**Advantage :** Easy to implement

**Disadvantages:** Image features can be severely corrupted due to illumination, noise, and occlusion. Feature boundaries can be weakened for faces, while shadows can cause numerous strong edges which together render perceptual grouping algorithms useless.

**Image based approach:**

Templates are learned from examples in images. In general, appearance-based methods rely on techniques from statistical analysis and machine learning to find the relevant characteristics of face and non-face images. The learned characteristics are in the form of distribution models or discriminant functions that are consequently used for face detection.

**Algorithm:** Convolution Neural-networks

**Advantages:** Difficult to implement.

**Disadvantages:** Dimensionality reduction is usually carried out for the sake of computation efficiency and detection efficacy,but it may reduce the accuracy of the model

**Reference :**

1. Face Detection Techniques: A Review

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2. Real-Time Human Detection, Tracking, and Verification in Uncontrolled Camera Motion Environments