ISSN : 2347 - 8446 (Online)
ISSN : 2347 - 9817 (Print)

Advanced Survey on Face Detection Techniques in Image Processing

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Abstract
This Face detection is used in biometrics, Face detection is one of the challenging problems in the image processing. This system contains the skin color which is the main feature of faces for detection, and then the skin face candidate is examined by using the neural networks, which learn from the feature of faces to classify whether the original image includes a face or not. Face detection can be regarded as a specific case of object-class detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. Early face-detection algorithms focused on the detection of frontal human faces, whereas newer algorithms attempt to solve the more general and difficult problem of multi-view face detection. Face detection is used in biometrics, often as a part of a facial recognition system. Many algorithms implement the face-detection task as a binary pattern-classification task, images with a plain or a static background are easy to process, method for human face detection from color videos or images is to combine various methods of detecting color, shape, and texture etc.

Fig. 1: Face Detection

Keywords
Image Processing, Face Detection, Face Recognition, Object Recognition, View-Based Recognition

I. Introduction

Face Detection: Face detection is the first stage of an automatic face recognition system, since a face has to be located in the input image before it is recognized. A definition of face detection could be: given an image, detect all faces in it (if any) and locate their exact positions and size. Usually, face detection is a two-step procedure: first the whole image is examined to find regions that are identified as "face". After the rough position and size of a face are estimated, a localization procedure follows which provides a more accurate estimation of the exact position and scale of the face. So while face detection is most concerned with roughly finding all the faces in large, complex images, which include many faces and much clutter, localization emphasizes spatial accuracy, usually achieved by accurate detection of facial features [1].

Face detection algorithms can be divided into four categories according to:

1. Knowledge-based methods are based on human knowledge of the typical human face geometry and facial features arrangement. Taking advantage of natural face symmetry and the natural top-to-bottom and left-to-right order in which features appear in the human face, these methods find rules to describe the shape, size, texture and other characteristics of facial features. A hierarchical approach may be used, which examines the face at different resolution levels. At higher levels, possible face candidates are found using a rough description of face geometry. At lower levels, facial features are extracted and an image region is identified as face or non-face based on predefined rules about facial characteristics and their arrangement. The main issue in such techniques is to find a successful way to translate human knowledge about face geometry into meaningful and well-defined rules. Another problem of such techniques is that they do not work very well under varying pose or head orientations.

2. Feature invariant approaches aim to find structural features that exist even when the viewpoint or lighting conditions vary and then use these to locate faces. Different structural features are being used: facial local features, texture, and shape and skin color. Local features such as eyes, eyebrows, nose, and mouth are extracted using multi-resolution or derivative filters, edge detectors, morphological operations or thresholding. Statistical models are then built to describe their relationships and verify the existence of a face. Neural networks, graph matching, and decision trees were also proposed to verify face candidates. Skin color is another powerful cue for detection, because color scene segmentation is computationally fast, while being robust to changes in viewpoint, scale, shading, to partial occlusion and complex backgrounds. The color-based approach labels each pixel according to its similarity to skin color, and subsequently labels each sub-region as a face if it contains a large blob of skin

color pixels. It is sensitive to illumination, existence of skin color regions, occlusion, and adjacent faces. There are also techniques that combine several features to improve the detection accuracy. Usually, they use features such as texture, shape and skin color to find face candidates and then use local facial features such as eyes, nose and mouth to verify the existence of a face. Feature invariant approaches can be problematic if image features are severely corrupted or deformed due to illumination, noise, and occlusion.

3. Template-Based Methods

To detect a face in a new image, first the head outline, which is fairly consistently roughly elliptical, is detected using filters, edge detectors, or silhouettes. Then the contours of local facial features are extracted in the same way, exploiting knowledge of face and feature geometry. Finally, the correlation between features extracted from the input image and predefined stored templates of face and facial features is computed to determine whether there is face present in the image. Template matching methods based on predefined templates are sensitive to scale, shape and pose variations. To cope with such variations, deformable template methods have been proposed, which model face geometry using elastic models that are allowed to translate, scale and rotate. Model parameters may include not only shape, but intensity information of facial features as well.

4. Appearance Based Methods

Face detection can be viewed as a pattern classification problem with two classes: "face" and "non-face". The "non-face" class contains images that may depict anything that is not a face, while the "face" class contains all face images.

II. Face Detection Algorithms

Information of skin color in a color image is a very popular and useful technique for face detection. The obvious advantage of this method is simplicity of skin detection rules that leads to construction of a very rapid classifier. We can use color information as a feature to identify a person's face in an image because human faces have a special color distribution that differs significantly, although not entirely, from those of the background objects. Previous studies have found that pixels belonging to skin region exhibit similar chrominance components within and across different human races. In the YCbCr color space, chrominance components are represented by Cb and Cr values. Thus, skin color model can be derived from these values. By using threshold techniques , skin color pixels are identified by the presence of a certain set of Cb and Cr values which corresponding to to the respective ranges of RCb and RCr values of skin color. Otherwise, the pixel is classified as non skin color. The system being designed into three main categories, pre-processing , segmentation, classification using neural networks

1. Pre-processing

Collecting a data set of skin face by cropping or cutting manually the image skin face and non-skin face to get a dataset of face and non-face. Different people have different skin color, while the difference lies mostly in the color intensity not in chrominance color itself. Literature survey show that YCbCr color space is one of the successful color spaces in segmenting skin color accurately .Selecting the suitable color space to model skin color and a void variation of lighting condition Cb and Cr Color space. Extract DCT coefficient features from Cb and Cr blocks

2 Segmentation Skin Color

Skin color information is very important features for many researches, however the accuracy of skin color detection is important for face detection [6].In this paper we convert the image from RGB to ycbcr .where are RGB is sensitive to the variation of intensity. Many skin detection method ignore the luminance component of the color space, to achieve independent model of the differences in skin appearance that may arise from the difference of human race, and also reduce the space dimension.

III. Survey of Face Detection Techniques

Proposed system is composed of two major components: first, skin regions are segmented using skin color model. In the second part, segmented regions are filtered using geometric model of face. They can focus on four representative color spaces which are commonly used in the image processing field:

A. RGB

Colors are specified in terms of the three primary colors: red (R), green (G), and blue (B). HSV: Colors are specified in terms of hue (H), saturation (S), and intensity value (V) which are the three attributes that are perceived about color. The transformation between HSV and RGB is nonlinear. The main goal in this segmentation process is to remove the background of the image from skin regions using previously discussed skin color model. First, input image is converted to chromatic color space. Using Gaussian model, a grayscale image of skin likelihood pixels is constructed and skin pixels have some set of constant values for each r, g and b component. Every pixel in normalized image has three values and they are normalized-red, normalized-green and normalized-blue. Segmentation process extracts these normalized components and constructs two images.

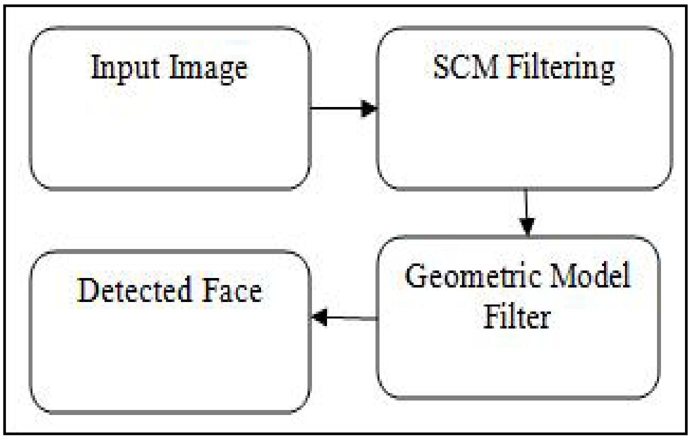

Fig. 2: Block Diagram of the Proposed Face Detection System

Their geometric modeling has three major steps. In the first step, detected skin regions are projecting using PCA. In the second step, projected skin regions are reconstructed using smaller number of Principal Components (PCs). Finally edges are detected from reconstructed skin regions. Since detected skin regions are in different size, each region is resized in to same resolution. A predefine mask is applied on each skink regions after resizing. Threshold value is rotation invariant because we are taking the cumulative sum of the projected geometric structure. Another advantage of the proposed method it is very fast in computation because of the filtering.

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1. Automatic and Robust Detection of Facial Features in Frontal Face Images

The proposed a robust algorithm for automatic and accurate detection of different facial features. An improvement over detection of eyes, mouth and nose are done by estimating the probable region for each features. geometrical interpretations of location of facial features, used in the algorithms are described with pictorial descriptions. It is observed that, with the use of facial geometry, the accuracy of features (eyes, nose and mouth) detection is greatly improved over that of using only the algorithm in whole face image. The proposed lip detection algorithm is found to be accurately detecting the lips corners for both neutral face images and smiling face images.

2. Cascade Detector for Rapid Face Detection

In this cascade algorithm, when an image was rejected by any stage, it is not calculated in the left stages. This cascade algorithm can discard the background images rapidly, but once a wrong detection occurs in one stage, this wrong detection will occurs in the detection. Then we proposed to use the results of the front stages to extend the current stage threshold. This cascade algorithm is good for discarding the background images rapidly, but it also discards the face images when a wrong detection occurs in any stage.

IV. Neural Networks

Neural networks have been applied in many pattern recognition problems like object recognition .there is many image based face detection using neural networks the most successful system was introduced by Rowley et al [3] as using skin color segmentation to test an image and classify each DCT based feature vector for the presence of either a face or non face . The neural networks used in this paper back probagation neural networks and was chosen because of simplicity and its capability in supervised pattern matching. The structure of the neural network with three layers , the input layer is a vector of 1xn DCT coefficient vectors of neuron from each image either face or non face image , the hidden layers has n neurons , and the output layer is a single neuron which is 0.9 if the face is presented and 0.1

V. Conclusion and Future Work

In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. It can be regarded as a more general case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces (usually one). In face detection, one does not have this additional information. Early face-detection algorithms focused on the detection of frontal human faces, whereas newer algorithms attempt to solve the more general and difficult problem of multi-view face detection. a new algorithm for face detection in the compressed domaian , exctracted DCT coffecient vector features after segmentation a face skin candidate using skin color information on both Cb Cr color space, along with backprobgation neural networks classifier. we have divided the problem into three stages pre-proocessing ,segmentation , and classification using backprobagation neural networks. The system has been tested on a dataset of upright frontal color face images from the internet and achived exellent detection rate..These methods as a future work, will improve the detection of faces in compressed images

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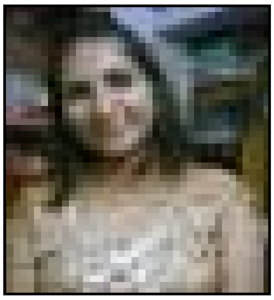

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