IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 1, March, 2013
ISSN: 2320 - 8791
www.ijreat.org

Combining Skin Color Based Classifiers And HAAR Feature Using VJ Algorithm

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Abstract

This paper presents a hybrid method for face detection in color images. The well known HAAR feature-based face detector developed by Viola and Jones (VJ), that has been designed for gray-scale images is combined with a skin-color filter, which provides complementary information in color images. The image is first passed through a HAAR Feature based face detector, which is adjusted such that it is operating at a point on its ROC curve that has a low number of missed faces but a high number of false detections. Then, using the proposed skin color post-filtering method many of these false detections can be eliminated easily. We also use a color compensation algorithm to reduce the effects of lighting. Our experimental results on the Bao color face database show that the proposed method is superior to the original VJ algorithm and also to other skin color based pre-filtering methods in the literature in terms of precision.

1. INTRODUCTION

The problem of face detection refers to determining whether or not there are any faces in a given image and to estimate the location and size of any detected faces[1]. Face detection is a trivial task for humans, however it is not very easy for computers due to geometric (scale, in-plane rotation, pose, facial expressions, occlusion etc.) and photometric variations. In the next subsection, face detection algorithms in the literature will be briefly reviewed.

Methods in the literature on face detection can be grouped as knowledge-based, feature-based, and template-based and appearance based methods[1,2,3]. Face detection is an expensive search problem. In general ,a sliding window is scanned through an image at various scales to classify the window as face or non-face. Therefore, many background windows need to be processed as well as actual face regions. The ratio of the number of non-face windows to face windows can be as high as 100000:1. Hence, a well trained classifier is necessary that will produce a low number of false positives. Face detection methods based on learning algorithms have shown good results. Viola and Jones (VJ) a frontal face detection system in gray-scale images based on the Adaboost learning algorithm.

The number of false detections in VJ algorithm increases when a high true detection rate is desired. For example, for a database containing 507 faces, there are over 150 false positives to achieve a true detection rate of about 93%[4]. This false positive rate is too high for some applications. The VJ face detector has been reported to fail if the face is[4] tilted beyond about 15 degrees in plane, rotated beyond about 45 degrees out of plane, towards a profile view. The works of Viola and Jones (VJ) have been extended to handle multi-pose (frontal to profile) faces and in-plane rotation. Skin-color is an effective cue for face detection since it is highly invariant to geometric variations of the face (pose, facial expressions) and fast to process. Skin-color has been shown to be useful for face detection.

Existing methods in the literature on face detection can be grouped as knowledge-based, feature-based, and template-based and appearance based methods. Face detection is an expensive search problem. In general, a sliding window is scanned through an image at various scales to classify the window as face or non-face. Therefore, many background windows need to be processed as well as actual face regions. The ratio of the number of non-face windows to face windows can be as high as 100000:1. Hence, a well trained classifier is necessary that will produce a low number of false positives.

2.PROPOSED WORK

We proposed skin color post-filtering method many of these false detections can be eliminated easily. We also use a color compensation algorithm to reduce the effects of lighting.

Our experimental results on the Bao color face database show that the proposed method is superior to the original VJ algorithm and also to other skin color based pre-filtering methods in the literature in terms of precision.

We propose a method that utilizes skin color detection to decrease the high false positive rate of the VJ face detector. The VJ algorithm uses only the brightness information in a search window, resulting in a high false acceptance rate due to face-like brightness patterns in the background. Therefore, skin-color is a complementary, channel of information, and it is very fast to process.

We propose a skin-color based post-filtering method for color images. The windows that are detected as face by the VJ algorithm are verified if the window contains sufficient number of skin pixels.

Maximize the overall true detection rate, we adjust the parameters of the VJ algorithm such that the number of misses is low, and the number of false detections is high. Most of the false detections are easily eliminated by the proposed skin-color based post-filtering method.

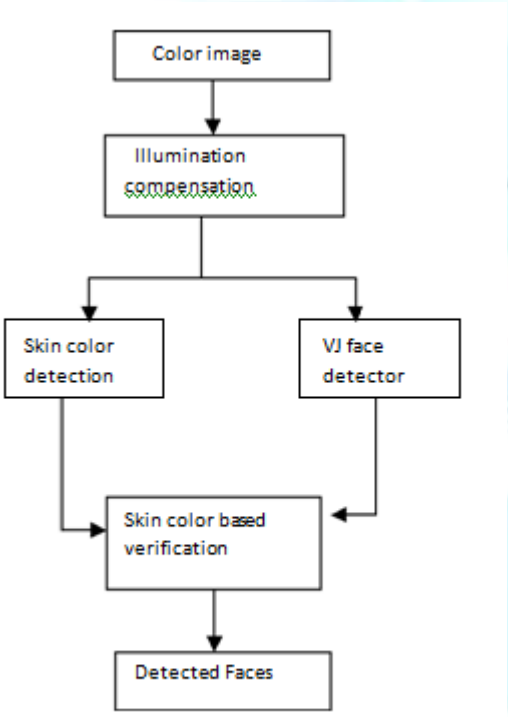


Fig. 1. The block diagram of the proposed face detection method.

2.1 SKIN COLOR DETECTION:

Skin-color is an effective cue for face detection since it is highly invariant to geometric variations of the face (pose, facial expressions) and fast to process. Then, we have to find the largest connected region. Then we have to check the probability to become a face of the largest connected region. If the largest connected region has the probability to become a face, then it will open a new form with the largest connected region. If the largest connected regions height & width is larger or equal than 50 and the ratio of height/width is then it may be face.

The skin detector detects whether certain regions in a color image represent human skin or not. It must define certain decision rules to discriminate between skin and non-skin pixels. To build these rules, a human skin model must be built. Several skin color modeling methods have been introduced [9].Skin color modeling methods can be classified into three main categories: explicitly defined skin regions, nonparametric skin distribution modeling and parametric skin distribution modeling. In explicitly defined skin regions, both the color space and the decision rules – the skin region boundaries - are found empirically. The main advantage of explicitly defined skin regions method is the simplicity of the classification rules and its speed. On the other hand its main challenge is the empirical choice of a proper color space and adequate decision rules. In nonparametric methods a skin color distribution is established using the training data without derivation of the explicit model of the skin color. The result of these methods is sometimes referred to as construction of skin probability map. Non-parametric methods are fast in building the skin model and classification but it requires large storage space to represent the training skin samples.

2.2 BAYESIAN CLASSIFIER:

The first skin color detection method that is used is based on a Bayesian classifier with histogram technique in RGB space. This method has been reported to be superior to other methods in terms of accuracy and computational cost for classifying pixels as skin and non-skin.

This results in an improvement in speed and a decrease in false positive rate. In the authors use a pre-filtering approach to detect candidate face regions and then use a hybrid set of features consisting of HAAR-like and Gabor Features to train various classifiers for faces in multiple poses.

2.3 FACE DETECTION:

we propose a method that utilizes skin color detection to decrease the high false positive rate of the VJ face detector. The VJ algorithm uses only the brightness .information in a search window, resulting in a high false acceptance rate due to face-like brightness patterns in the background. Therefore, skin-color is a complementary channel of information, and it is very fast to process.

In order to achieve a low false detection rate while keeping a high true detection rate, we propose a skin-color based post-filtering method for color images. The windows that are detected as face by the VJ algorithm are verified if the window contains sufficient number of skin pixels.

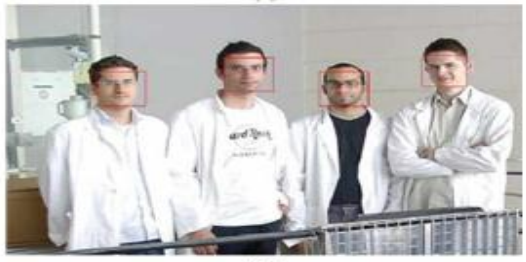
To maximize the overall true detection rate, we adjust the parameters of the VJ algorithm such that the number of misses is low, and the number of false detections is high. Most of the false detections are easily eliminated by the proposed skin-color based post-filtering method.

2.4 HAAR FEATURES:

We presented a face detection method based on an over-complete set of HAAR-like features which are calculated in scaled analysis windows. The rectangular HAAR-like features are sensitive to edges, bars and other similar structures in the image and they are computed using an efficient method based on the integral image concept.

After calculation of a huge number of features for each analysis window, the AdaBoost algorithm is used for combining a small number of these features to form an effective classifier. For example, for an analysis window of size 24 × 24, there are approximately 160, 000 features, far more than the number of pixels. A variant of AdaBoost is used both to select the best features and to train the final classifier.

(a)



(b)

3. CONCLUSION

We presented a method for combining the Haar feature based face detector which uses brightness information with a skin-color classifier in a post-processing framework. We compared two methods for skin pixel classification: Bayesian method with the histogram technique and the explicit method. We also used an illumination compensation step prior to skin color detection. The experimental results on the Bao color face image dataset show that the skin-color post-filtering method using the Bayesian classifier is superior to the original VJ algorithm and a pre-filtering method in the literature. We plan to do experiments on more extensive color face databases. We also plan to improve the skin-color based face detection algorithm to further decrease the number of false negatives.

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