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Face Detection & Smiling Face Identification Using Adaboost & Neural Network Classifier

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Abstract— Face detection in images is a computer technology that examines the problem of detecting the locations in arbitrary (digital) images where faces are present. In other words, given a single image, the goal is to determine whether or not there are any faces in the scene and, if present, return the specific location and fit each face into the bounding box defined by the image coordinates of the corners. Smile detection in face images is an interesting problem in many applications. Here we present an efficient approach to face detection and corresponding smiling face identification using Adaboost and Neural network classifier.

Index Terms— Adaboost, Artifial Neural Network, Face Detection Rate.

1 Introduction

HUMAN has special skill in analyzing and interpreting faces, and so face analyzing has an important role in man machine relationship and different research areas has been opened in this way. Face detection is considered to be the first task performed while processing scenes for varied purposes and its results are important for subsequent steps of automated human face recognition. Therefore the whole process should work predictably and quite reliably. Designed systems are then used in biometrics (facial recognition systems for automatically identifying or verifying a person, including applications for visual surveillance and security), vision-based human-computer interfaces, image database management or camcorder sphere (developing digital cameras or cell phones using autofocus in so-called Face Priority Mode to better capture people in still photography and video). To build these fully automated systems that analyze the information contained in face images, robust, fast and quality face detection algorithms are required.

Face detection is a difficult task in image analysis which has each day more and more applications. The existing methods for face detection can be divided into image based methods and feature based methods. We have developed an intermediate system, using a boosting algorithm and neural network to train a classifier which is capable of processing images rapidly while having high detection rates. AdaBoost is an aggressive learning algorithm which produces a strong classifier by choosing visual features in a family of simple classifiers and combining them linearly. This is the model of combining AB and ANN for detecting faces. In this model, ABs have a role to quickly reject non face images; then ANNs continue filtering false negative images to achieve better results. The final result is face/non face.

A smile is the most common facial expression that occurs in people daily life. In many practical applications, speed or computational efficiency is a key concern. Because of the limited computational resource, it is highly desired that the features used can be computed easily and efficiently. It introduced to use the relationship between two pixels' intensities as features. They obtained high accuracy on face orientation discrimination and gender classification by comparing the intensities of a few pixels. More specifically, they used five types of pixel comparison operators (and their inverses). It combines the feature selection and classifier training steps in one process.

2 Literature Survey

The face detection problem is pretty old and many algorithms have been proposed. Therefore, only some of the latest approaches often used for comparison will be mentioned here.

Schneiderman et al adopted a fully Bayesian approach. The final decision rule is a simple likelihood ratio test. Both class conditional density functions are modeled as a product of a big number of likelihoods of a single visual attribute where the attributes are assumed independent. The likelihoods are modeled as histograms. The visual attributes used are based on the quantized wavelet coefficients to allow localization of the attributes in space, scale and orientation.The detector is able to detect either frontal faces or profiles but is again relatively slow.

Yang et al use the SNoW architecture to build a classifier. The SNoW(Sparse Network of Winnows) architecture is similar to the perceptron but with very high number of inputs (possibly infinite). Few of them are "active" and the rest "inactive". The inputs correspond to the features in the example images. Measured values in an image determine which input features becomes active. Weights of connections between active inputs and output are summed and thresholded. If prediction mistake is made the weights are increased or decreased, depending on the type of mistake (missed detection or false alarm). The weighted sum is similar to the AdaBoost algorithm, yet the feature set reduction is not so immense. The speed of the evaluation is higher but still does not allow a real-time performance.

Although there is large amount of literature of facial expression recognition few papers have focused specifically on smiling face identification.

3 AB-ANN CLASSIFIER

Face detection and recognition is the problem to search human faces in large image database. In detail, a face recognition system with the input of an arbitrary image will search in database to output people's identification in the input image. The face recognition includes the processing in figure .Thus, the face detection processing is the first step of the face recognition system. The step will decide the efficiency of the system, so it is the most important step of the recognition system. Hence, the study only focuses on this step. To carry out it efficiently, many researchers have proposed different approaches.

A method of detecting face is to classify the pattern in the sub window as either face or non face. The classifier is trained by the training set which include face images and non face images taken under different conditions or extracted in the process of running the program. Face images for training are a part of faces, including left and right eyes, noses and mouths in Figure 1a; non face images for training do not contain any part of faces in Figure 1b. Training 20x20 images are used for training classifiers. The trained classifiers are able to classify a part of image as face or non face. In detail, a sub window 20x20 will be slid on a full image (resized to 120x90). The sub window is verified by the classifiers to contain a face or not.

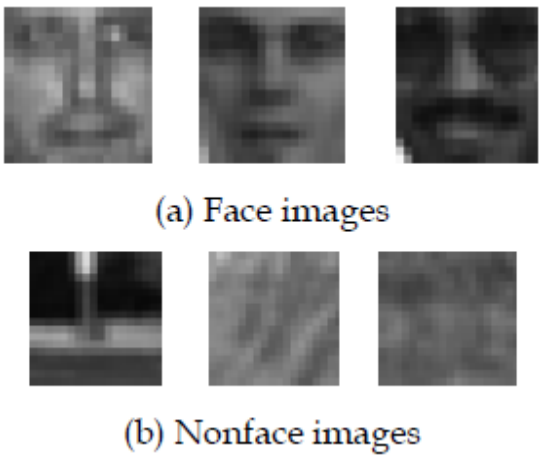

Fig 1: Images for training classifiers

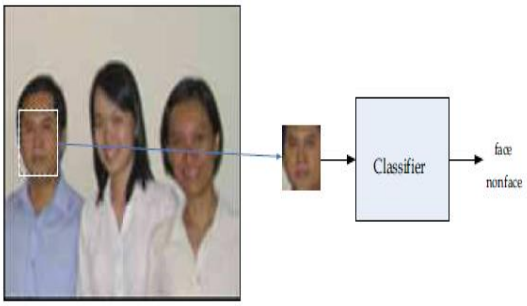

Fig 2: Classifier 's process for detecting face

Building the classifier is quite feasible because pixels on face images have high correlation to totally describe face structures while ones on nonface images have not the characteristic. One of the most popular and efficient learning machine based approaches for detecting faces is AdaBoost approach .Viola designed a fast, robust face detection system where AdaBoost learning is used to build nonlinear classifiers. AdaBoost is used to solve the following three fundamental problems: (1) learning effective features from a large feature set; (2) constructing weak classifiers, each of which is based on one of the selected features; and (3) boosting the weak classifiers to construct a strong classifier. Viola et al. make use of several techniques for effective computation of a large number of such features under varying scale and location which is important for real-time performance. Moreover, the simple-to-complex cascade of classifiers makes the computation even more efficient, which follows the principles of pattern rejection and coarse-to-fine search. Their system is the first real-time frontal-view face detector, and it runs at about 14 frames per second on a 320×240 image (M. H. Yang et al., 2002). However, to achieve high ratios of detecting faces, we must increase the number of classifiers and Haar-like features. It will cause a significant increase in the performance time. Thus to deal with the issue, we should combine AdaBoost with other machine learning techniques to still achieve both the same face detecting ratios and the minimum performance time. One of the popular methods having the same achievement as well is Artificial Neural Networks (H. A. Rowley et al., 1999). ANN is the term on the method to solve problems by simulating neuron's activities. In detail, ANNs can be most adequately characterized as 'computational models' with particular properties such as the ability to adapt or learn, to generalize, or to cluster or organize data, and which operation is based on parallel processing. However, many of the previous mentioned properties can be attributed to non-neural models.

In the study, a hybrid approach combining AdaBoost and ANN was suggested to detect faces with the purpose of decreasing the performance time but still achieving the desired faces detecting rate.. In this model, AdaBoost have a role to quickly reject nonface images; then ANN continue filtering false negative images to achieve better results. The final result is face/nonface.

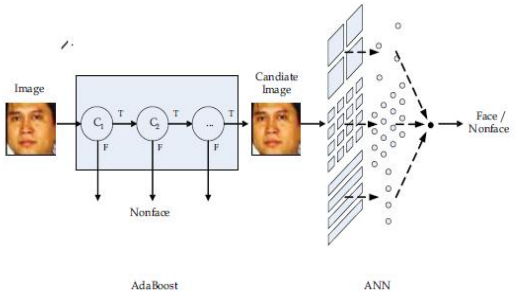

Fig 3: Adaboost and ann based system

4 Smiling Face Detection

A vital step in facial analysis is extracting effective features from orginal face images**.** In many practical applications, speed or computational efficiency is a key concern. Because of the limited computational resource, it is highly desired that the features used can be computed easily and efficiently. It introduced to use the relationship between two pixels' intensities as features. They obtained high accuracy on face orientation discrimination and gender classification by comparing the intensities of a few pixels. More specifically, they used five types of pixel comparison operators (and their inverses). It combines the feature selection and classifier training steps in one process.Here we examine the relationship between two pixels intensities as image features.given the large number of features the next step is to minimize the number of features that need to be computed . We use adaboost for this purpose.

6 Simulation Results

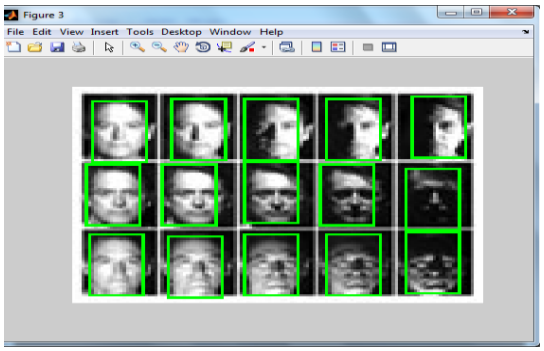

Fig 4: Face Detection

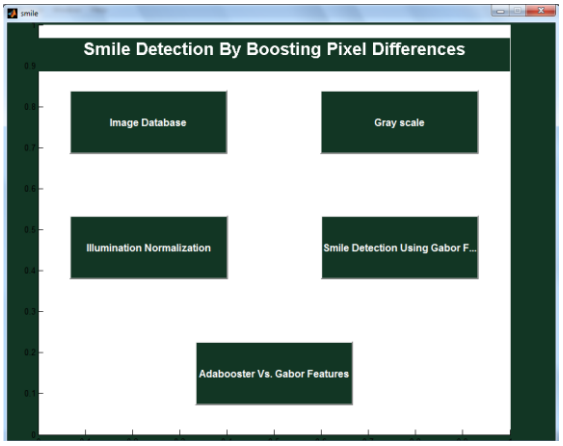

Fig 5: GUI of smiling face detection

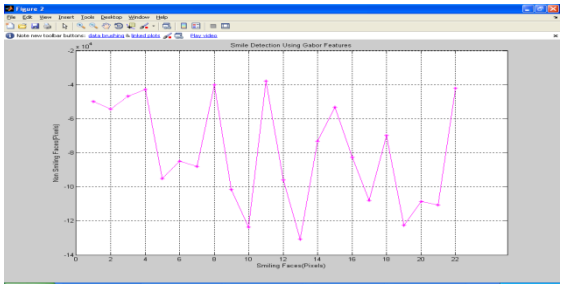

Fig 6: Smile detection

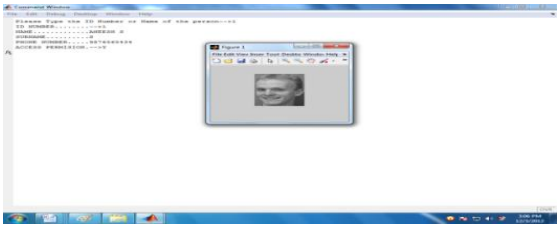

Fig 7: Identification of Smiling Face

7 Conclusion

The two popular methods of detecting faces are presented, AdaBoost and ANN, analyzing, evaluating ones' advantages and disadvantages. From the study, AdaBoost (cascade of boosted AdaBoost) has the fastest performance time; however the correctness rate is not high (because detection results depend on weak classifiers or Haar-like features); and it is proved by the experiments. Also boosting of intensity difference between pixels in the grey scale face images are used as simple feature for smile detection.

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