Paper Presentation - Computer Vision

By : Harpreet Kour, Saurav Jayakumar, and Utkarsh Darbari

Paper : Detection of Face Wearing Mask Based on AdaBoost and YCrCb

Link : https://ieeexplore-ieee-org.offcampus.lib.washington.edu/document/10030579

S. Zhang, Y. Xue, M. Chen and S. Niu, "Detection of Face Wearing Mask Based on AdaBoost and YCrCb," 2022 4th International Conference on Electrical Engineering and Control Technologies (CEECT), Shanghai, China, 2022, pp. 349-353, doi: 10.1109/CEECT55960.2022.10030579.

Published in: 2022 4th International Conference on Electrical Engineering and Control Technologies (CEECT)

Introduction

This paper uses OpenCV to propose a face detection algorithm based on AdaBoost. This algorithm is based on face detection, including initialization of background estimation example, background subtraction preprocessing, obtaining eye position, face detection and other steps. LBP features are used as the training basis of the classifier. The trained classifier is generated and used as a function in the mask detection algorithm.

Aiming at the current research problems, this paper has solved some difficulties:

1. In view of the non-standard wearing of masks, the detection accuracy of masks covering the nose and mouth is high.
2. It can better control the external environment interference and realize real-time video mask detection.

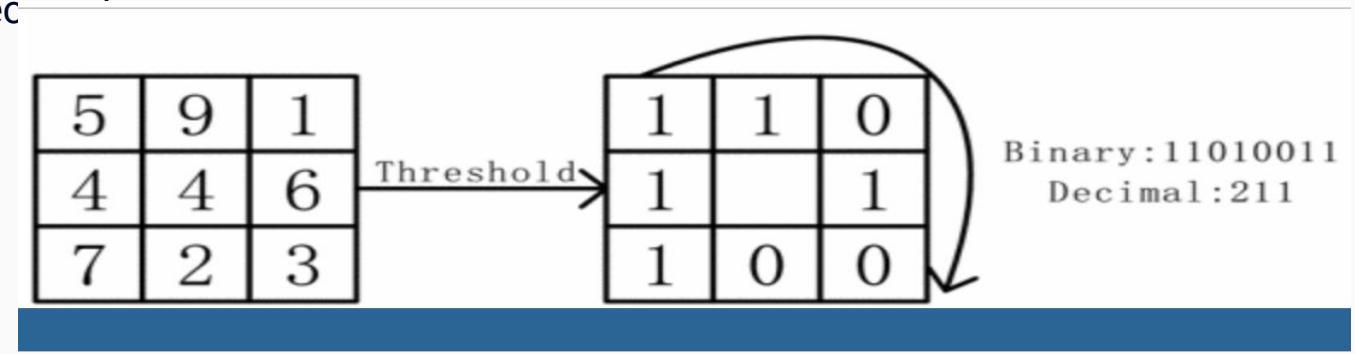
Adaboost Cascade Classifiers Using Lbp Features

AdaBoost combines the trained weak classifiers into more complex classifiers in a cascade manner for the same training set, and finally forms a stronger strong classifier. Generally, a strong classifier is composed of 15 to 20 weak classifiers. When AdaBoost algorithm is used to detect faces, Haar features are used to quantify the face features, so as to detect faces and non faces. A large number of weak classifiers are trained and combined into a series of strong classifiers by AdaBoost algorithm using multi-layer verification method. In the process, each layer will discard a large number of counterexamples, while the positive examples must be verified layer by layer. The expression of AdaBoost is given by :

$$f(x) = \sum_{m=1}^{M} \alpha_m G_m(x)$$

LBP(Local Binary Pattern) Characteristics

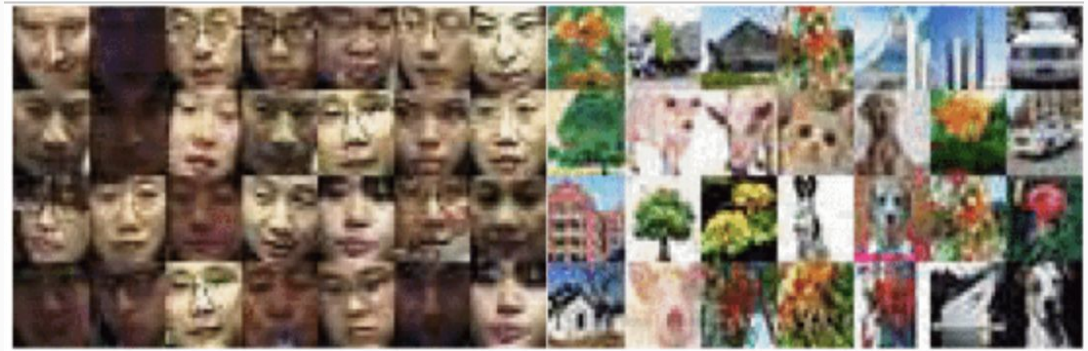
LBP feature is an operator used to describe the local texture features of an image. It labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. For face recognition, LBP features can more clearly reflect the texture features of each area of the image while weakening the smooth area features that are not valuable for face rec...



Classifier Training

Positive sample include **18687 20 * 20** face positive images

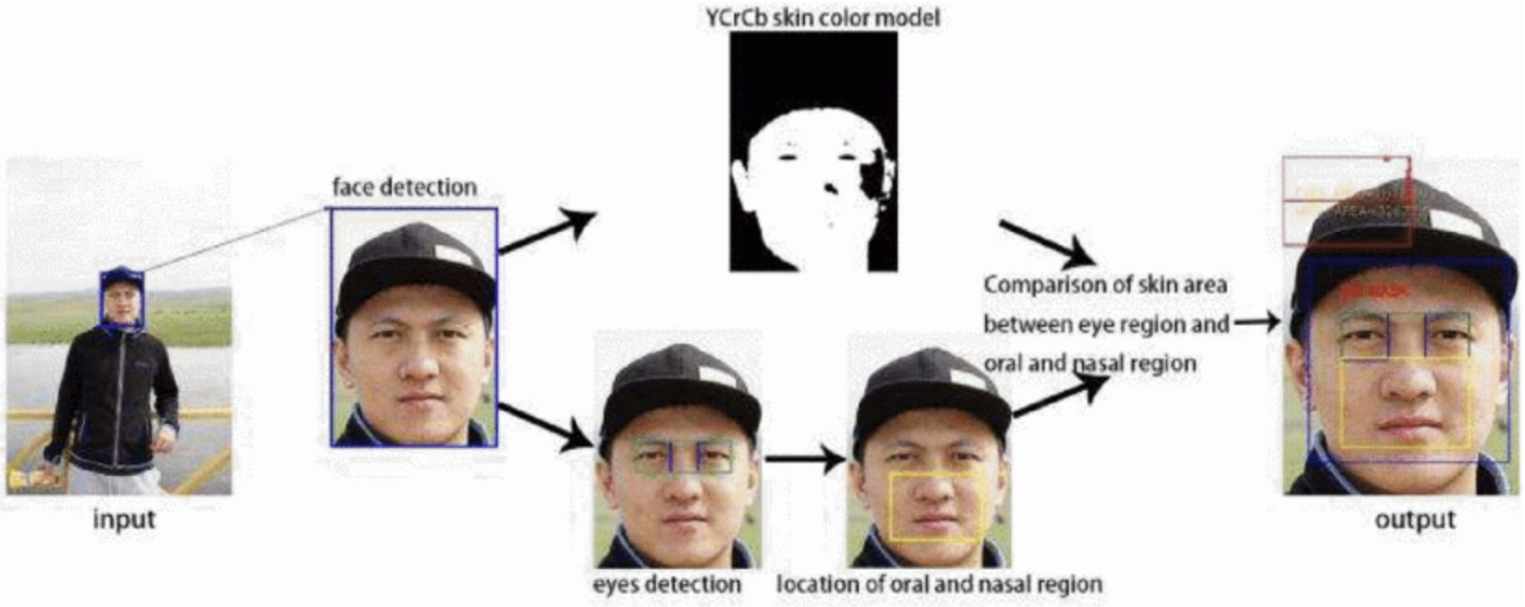
Negative face samples include **10925 20 * 20**



(a) (b)

The LBP encoded image samples and their weights are used as input for AdaBoost model training. The weak classifier is weighted by gradient descent method to generate the weight coefficients of the weak classifier at this level and the weights of the next level training model. When the termination condition is met: the number of stages reaches the set value or the total error rate is less than the set value, the training is completed.

Methodology



The specific implementation process is shown in the figure. First, face classifier is used for face recognition and face selection is established. Then the eye area is determined by eye recognition and the mouth and nose area is calculated. At the same time, YcrCb face skin color model is established in the face selection area. Finally, the skin color areas of the eye area and the mouth and nose area are calculated, and the final output results are obtained by comparing the two areas.

Implementation Method

A. Image Preprocessing
B. YCrCb Skin Colour Model
C. Oronasal Region (oronasal region) Selection
D. Comparison of Skin Area Between Eye Region and Oral and Nasal Region

Algorithm Experimental Verification

TABLE I. TEST RESULTS

INPUT	OUTPUT		
	Have mask	*No mask*	*Half wearing mask*
Have mask	86	1	2
No mask	6	109	21
No eye detecgted	18	15	7
Total	110	125	30

- The failure to recognize human eyes will lead to the failure to detect the wearing of masks.
- If human eyes can be recognized successfully, the algorithm has a high accuracy rate for the detection of mask wearing.

TABLE II. EVALUATION INDICATORS

Sample size	Recognition rate	Accuracy	Preciseion	Recall
265	84.9%	96.6%	96%	93.4%

Conclusion

- An **effective design method** based on **AdaBoost for single face mask wearing detection** algorithm.
- In order **to improve the recognition rate and accuracy** of the algorithm in the natural environment, image **preprocessing methods** such as gray image conversion and histogram equalization **are cited**.
- **HSV components** with variable thresholds are used for real-time video detection, and **Cr components of YCrCb color space+Otsu method threshold** segmentation algorithm are **used for image detection.**
- The algorithm can also **accurately identify the non-standard wearing of masks**, and the overall applicability of the algorithm is strong.

- Shortcomings:
  - When the **face area is small,** it is **difficult to identify the human eye,** so there is a missing situation.
  - **Interference** such as shadows in the image will **lead to false detection of human eye** recognition, and ultimately the wearing condition of the mask cannot be recognized
  - The algorithm is only applicable to the detection of **single face frontal objects**, and has a **high miss rate for inclined faces.**