Human Face Detection in Color Image Based on C 4.5 Classifier

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Abstract

This paper present a new face detection algorithm based on human face feature. Method of YCbCr skin color space which is color segmentation of human face for regional analysis and extraction. Then we can use sobel edge detector to get edge which is boundaries between face regions and between face regions and image. Then we use convolution filter to remove noise.

1. Introduction

Face detection is a necessary first step in face recognition system; with the purpose of localizing and extracting the face region from the background. The skin color feature that is one kind of the most important physical surface features contains more information. Face detection is a challenging computer vision problem. The goal of face detection is to locate all regions that contain a face regardless of any three dimensional transformation and lighting condition. There are two main categories that may serve as solution for this problem: feature-based and image–based approaches automatic recognition of human faces is one of the most difficult and important problem in the area of pattern recognition and commutation vision. Skin color has proven an effective feature for face detection [1, 2]. Many researches show that skin color difference between races exist chrominance.

2. Color space

Several color spaces have been utilized to label pixels as skin including RGB, normalized RGB, HSV YCbCr, CIE, LUV etc [1]. Skin color is a powerful fundamental feature of human face among the face detection algorithm which is based on skin color information and the speed of processing color is faster than other facial features. So skin color detections firstly performed on the input color image to reduce the computational complexity the YCbCr .color space is used widely in video compression standards. Equation for transformation between RGB to YCbCr is given

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} \begin{bmatrix} 65.48 & 128.55 & 24.9 \\ -37.79 & -74.20 & 112.0 \\ 112.00 & -93.78 & -18.21 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

In the YCbCr the luminance information is represented by single component Y and color information is stored as two color difference, Cb and Cr [1]. Cb is the difference between blue component and reference value, and Cr is the difference between red component and reference value.

3. Segmentation

In computer vision segmentation refers to the process of partioning a digital image in to multiple segments. Set of pixels also known as super pixels. Image segmentation is typically used to locate object and boundaries in images. It is a process of assigning a label to every pixel in an image.

- The main purpose of this is to find the region in an input image that might potentially contain faces .First read in an image. It could be either a color or gray level image. Then convert this input image to a binary image [1]. If this input image is not grayscale format then convert this grayscale image to binary image by thresholding.
- Preprocesses the inputted image to binary image. In this first convert the input image to a binary image. For example, when we read in a RGB color image, we will preprocess the input image, to gray level image, by eliminating hue and saturation information while retaining the luminance [3]. The gray level image to a" binary image by simple global thresholding with threshold T because the object of interest in our case are darker

than background. Before proceeding to the next step we perform the opening operation (erosion first, then dilation) to remove noise and then closing operation (dilation first then erosion) to eliminate holes.

- Label all components and find the center of each block. Here, we use raster scanning (left to right top to bottom), to get image component, label them and then find center of each block.

Figure1.Original image

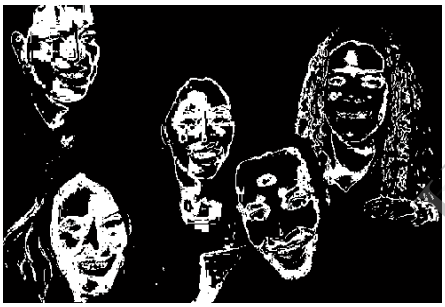


Figure2.Color segmentation result

4. Edge Detection

We propose the method of combining skin segmentation and edge extraction (sobel operator). First we apply sobel operator detection algorithm on the gray scale version of the original image and get an edge image [2]. Finally we get the edge which is boundaries between face region and background by logic and operation of the binary image and the edge image.

- *Convolution filter*

Here we use convolution filter for the final image to remove noise, Convolution filter is frequency domain method based on convolution theorem

$$g(x,y) = h(x,y) * f(x,y)$$

Where f(x, y) is the input image h(x, y) is a position invariant operator and g(x, y) is the resultant image from convolution filter [2].

$$G(u, v) = H(u, v)\, F(u, v)$$

G, H, F is Fourier transforms of g, h, f respectively. Linear filtering of an image is accomplished through an operation called convolution.

Fig3.Edge detection by the sobel operator

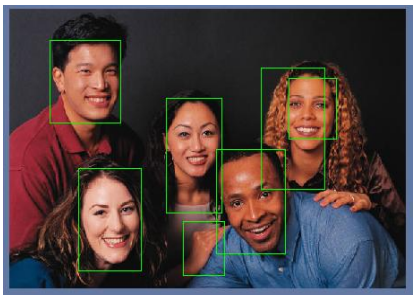
5. Morphological operation

Morphological operations simplify, quantify and preserve the main shape characteristics of the object. We can get a more accurate contour of the skin segment when using it. We fill face region by applying morphological operation with a 3-by-3 structuring element. Dilation adds pixels to the boundaries of objects in an image. Dilation expands an object of the closest pixels of the neighbourhood. Dilation is used to fill small holes in the object. Erosion shrink the object or removes pixels on object boundaries [4].The number of pixels added or removed from the objects in an image depends on the size and shape of structuring element used to process the image. The value of the output pixels is the maximum value of all the pixels in the input pixels neighbourhood. In a binary image if any of the pixels is set of the value 1, the output pixels are set to 1.The value of the output pixels is the minimum value of all the pixels is the input pixels neighbourhood [5, 6]. In a binary image, if any of the pixels is set 0 the output pixels are set to 0.

6. Experimental results

In this paper, the MATLAB (7.8.0) simulated experiments are performed to verify the accuracy of our combined method. Most of the commonly used

databases for face detection, including Google searched group image. Therefore, we construct database for face detection and low brightness from personal photo collection. The images are digital photos from life and collected stochastically from the interest and these images contain multiple faces with variations in color, position, scale orientation and facial expression compose testing set. Experimental results using the proposed method show that the new approach can detect face with high with high detection rate and low false alarms and misses still exist. The statical data is show in Table.1



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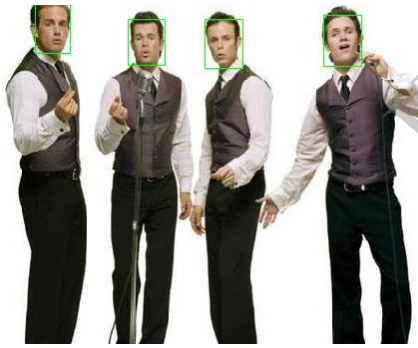
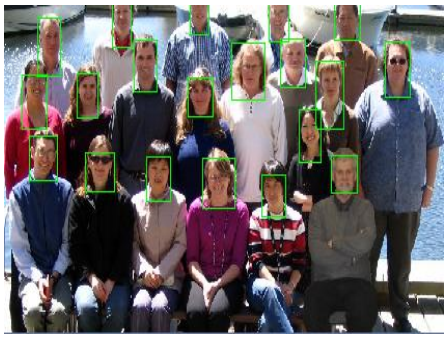




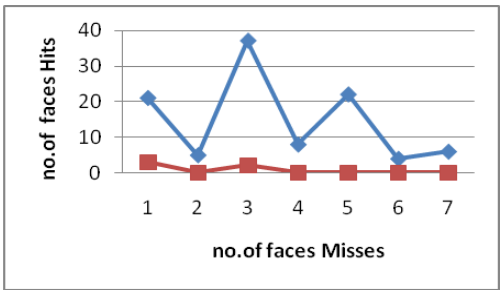
The size of bounding box surrounding the skin color region is denoted by area, must be denoted by 400.both the height and width of bounding box are greater than 20.In general, the height to width ratio of human face is around 1.

Fig.4 Examples of detected face in color images

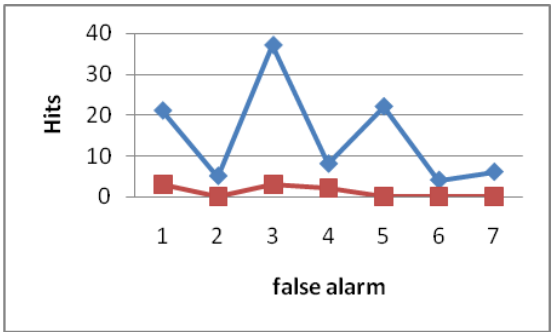
Table1. Statical data

I No. of image	Face no.	Hits	False alarm	Misses	precision
1	24	21	3	3	87.5%
2	5	5	0	0	100%
3	39	37	3	2	94.9%
4	10	8	2	0	100%
5	22	22	0	0	100%
6	4	4	0	0	100%
7	6	6	0	0	100%
Total	110	103	8	5	95.5%

Graph1. No of faces Hits Vs faces misses



Graph 2. No of faces Hits Vs false alarm



7. Conclusion

In this paper, a robust and effective face identification system is presented to extract face in various kinds of face images. Experimental result shows that the Paper can achieve high detection accuracy, high detection speed and reduce the false detecting rate and missing rate.

References

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