Face detection and the effect of contrast and brightness

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Abstract

We propose a system to detect human faces in color images type BMP by using two methods RGB and YCbCr to determine which is the best one to be used, also determine the effect of applying Low pass filter, Contrast and Brightness on the image. In face detection we try to find the forehead from the binary image by scanning of the image that starts in the middle of the image then precedes by finding the continuous white pixel after continuous black pixel and the maximum width of the white pixel by scanning left and right vertically(sampled w) if the new width is half the previous one the scanning stops.

Keywords: *Low Pass Filter, Contrast , Brightness*

1.Introduction

The goal of face detection is to determine whether or not there is any human face in the image. In recent years, many methods have been proposed to detect human faces in a single image or a sequence of images based on gray scale or color[1].

Using skin-color as a feature for tracking a face has several advantages; and tracking human faces using color as a feature has several problems[2]. First, the color representation of a face obtained by a camera is influenced by many factors such as ambient light, object movement, etc. Second, different cameras produce significantly different color values even for the same person under the same lighting condition. Finally, human skin colors differ from person to person.[3]

In this proposed system we are using two methods for detecting pixels with skin color; using RGB-space and YCrCb-space, then the skin samples were filtered using a low-pass filter to reduce the effect of noise in the samples. For face detection, first we convert binary image from RGB image and find the forehead from the binary image by scan from the middle of the image. we will analyze some interesting aspects of image processing and how these effects to face detection when we using Brightness and contrast[4] .

2.The proposed system

2.1.Input Image

we need to acquire the input image type BMP. Now, there are various ways like, we can take some picture using a camera or database images can be used for quicker access of a huge amount of images.

2.2.Skin Color Segmentation

Detection of skin color in color images is a very popular and useful technique for face detection, one approach is to first classify the pixels to be "skin" or "not skin" pixels. When the "skin" pixels have been found, the noise is removed and pixels are combined to create larger groups[2].

The skin color seems to be quite easy to spot, "just choose pixels which loosely matches skin color". But actually the problem is more difficult than it first seems. The skin color varies from dark to light and is heavily influenced by lightning**[5].**

Skin color is relatively concentrated and relative stabilization of region in the color image, and it is not to influence by shape, size and so on. In recent years, skin color detection has become a hot topic between domestic and foreign researchers, and great progress has been made in this field [6].

In this research we are using two methods for detecting pixels with skin color; using RGB-space and YCrCb-space.

The common RGB representation of color images is not suitable for characterizing skin-color. In the RGB space, the triple component (r, g, b) represents not only color but also *luminance*. Luminance may vary across a person's face due to the ambient lighting and is not a reliable measure in separating skin from non-skin region **[7]**.

Skin color cluster in RGB color space(R,G,B) is classified as skin if[5]:

$$R > 95 \text{ and } G > 40 \text{ and } B > 20 \text{ and}$$
$$\max\{R,G,B\}-\min\{R,G,B\} > 15 \text{ and}$$
$$|R-G| > 15 \text{ and } R > G \text{ and } R > B$$

Mainly transforms the high relevance of color component in RGB color space to the small relevance of color component in YCbCr color space**.** we need to convert RGB color values to YCrCb color values. To convert RGB color values to YCrCb color values we can use following formula [8]:

$$Y = (0.257*R) + (0.504*G) + (0.098*B) + 16$$
$$Cr = (0.439*R) - (0.368*G) - (0.071*B) + 128$$
$$Cb = -(0.148*R)- (0.291*G) + (0.439*B) + 128$$

Using these values we can classify (Y,Cr,Cb) as skin if [3]:

$$Cr <= 1.5862 \times Cb + 20 \text{ AND}$$
$$Cr <= 0.3448 \times Cb + 76.2069 \text{ AND}$$
$$Cr <= -4.5652 \times Cb + 234.5652 \text{ AND}$$
$$Cr >= -1.15 \times Cb + 301.75 \text{ AND}$$
$$Cr >= -2.2857 \times Cb + 432.85 \text{ AND}$$

Many skin samples from many color images were used to determine the color distribution of human skin in chromatic color space[5]. As the skin samples were extracted from color images, the skin samples were filtered using a low-pass filter to reduce the effect of noise in the samples. The impulse response of the **low-pass filter** is given by:

$$1/9 \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$$

The most basic of filtering operations is called "low-pass". A low-pass filter, also called a "blurring" or "smoothing" filter, averages out rapid changes in intensity[9]. The simplest low-pass filter just calculates the average of a pixel and all of its eight immediate neighbors. This low-pass filtered image looks a lot blurrier[10]. But why would you want a blurrier image? Often images can be noisy – no matter how good the camera is, it always adds an amount of ”snow” into the image. The statistical nature of light itself also contributes noise into the image**[9]**.

Noise always changes rapidly from pixel to pixel because each pixel generates its own independent noise. The image from the telescope isn't "uncorrelated" in this fashion because real images are spread over many pixels. So the low-pass filter affects the noise more than it does the image. By suppressing the noise, gradual changes can be seen that were invisible before. Therefore a low-pass filter can sometimes be used to bring out faint details that were smothered by noise[10].

2.3. Face Detection

For face detection, first we convert binary image from RGB image. Binary images are images whose pixels have only two possible intensity values[1]. They are normally displayed as black and white. Numerically, the two values are often 0 for black, and either 1 or 255 for white[11]. For converting binary image, we calculate the average value of RGB for each pixel and if the average value is below than 110, we replace it by black pixel and otherwise we replace it by white pixel. By this method, we get a binary image from RGB image, see fig1:

a b

Fig1. a:RGB Image b:Binary Image

Find the forehead from the binary image by scan from the middle of the image, to find a continuous white pixels after a continuous black pixel[12]. Then we want to find the maximum width of the white pixel by searching vertical both left and right site[1], if the new width is smaller half of the previous maximum width, then we break the scan and cut the face from the starting position of the forehead and its high will be 1.6 multiply of its width, see fig2:

a b

Fig2. a: Find the Forehead b:Cut the Face

We can see the proposed system in fig3:

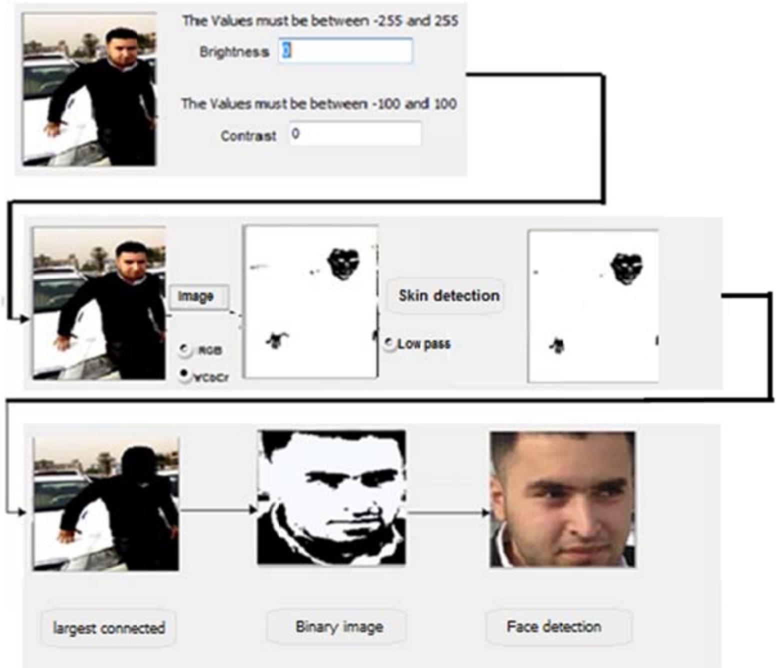


Fig3. The Proposed System

When the image contains multiple faces, the program detects the one with the widest forehead, see fig4:

Image skin detection largest connected binary image face detection

Fig4. Image Contains Multiple Faces

Continuing to use the same image, the next detection would be the second widest face as shown in fig5:

Image skin detection largest connected binary image face detection

Fig5. Next Detection Would be the Second Widest Face

3.The Effects of Applying Contrast and Brightness on the Image

There can be different results for the same input image and skin-color model. In this proposed system, we will analyze these effects:


Image skin detection largest connected region binary image face detection

Fig6. Example with Contrast 0


Image skin detection largest connected region binary image face detection

Fig7. Example with Contrast 50


Image skin detection largest connected region binary image face detection

Fig8. Example with Contrast 100


Image skin detection largest connected region binary image face detection

Fig9. Example with Contrast -35

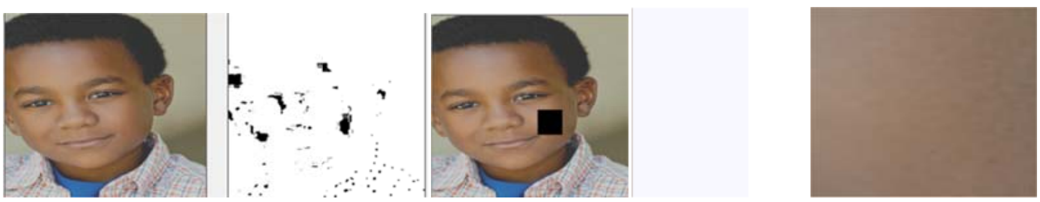


Image skin detection largest connected region binary image face detection

Fig10. Example with Contrast -40

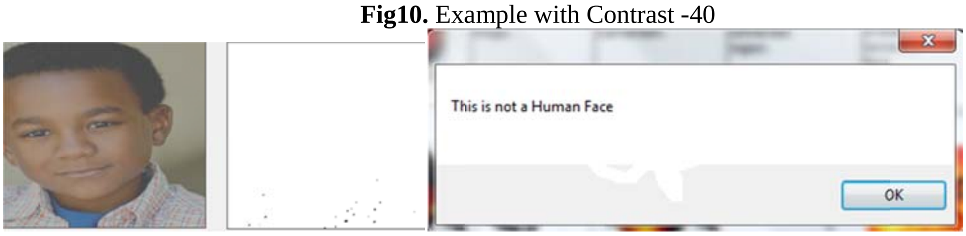


Image skin detection largest connected region binary image face detection

Fig11. Example with Contrast -50

Whenever the Contrast reaches less than -40, face detection becomes impossible, and the message "This is not Human Face " is shown when the contrast becomes-50.

Image skin detection largest connected region binary image face detection

Fig12. Example with Brightness 50

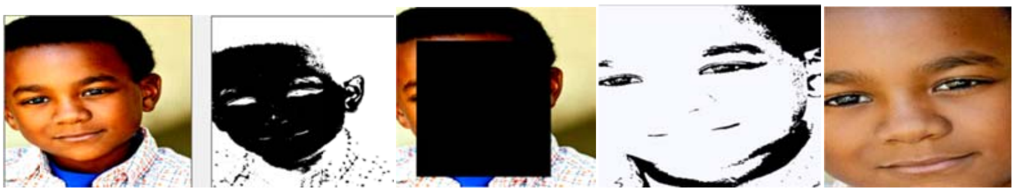


Image skin detection largest connected region binary image face detection

Fig13. Example with Brightness 100

Image skin detection largest connected region binary image face detection

Fig14. Example with Brightness 200

Image skin detection largest connected region binary image face detection

Fig15. Example with Brightness -35

Image skin detection largest connected region binary image face detection

Fig16. Example with Brightness -50

Image skin detection largest connected region binary image face detection

Fig17. Example with Brightness -100

In Brightness , the less negative value becomes the more, it will affects the face detection in an image

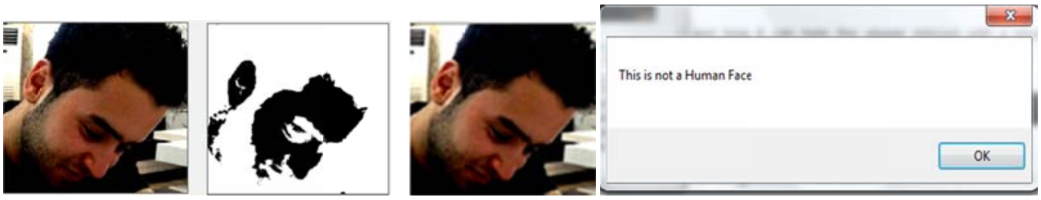
4. Conclusion

1.We compared evaluation of different color representation and found out that YCbCr model unlike RGB, it has separate luminance and chrominance components which make this color space attractive for skin color segmentation then is better than RGB one.
2. It is based on the fact that the results of images of people having white skin are better.
3.The skin samples were filtered using a low-pass filter to reduce the effect of noise in the samples greatly helped in determining face better and especially the faces on both sides of the form, see fig18 and 19:

Fig 18. Without Using Low Pass Filter

Fig 19. Using Low Pass Filter

4.When the image contains multiple faces, the program detects the one with the widest forehead, continuing to use the same image, the next detection would be the second widest face as the first one has already been selected and ignored by the program, and so on. System reveals the face of one of the image containing more than face.
5.Using Contrast and Brightness in the system shows that the Contrast reaches less than -40, face detection becomes impossible, and the message "This is not Human Face " is shown when the contrast becomes-50, and experiments have shown that face region can be detected effectively of this system when we increasing the contrast, see fig20 and fig21contrast equal 100:



no contrast

Fig20. Shows "This is not a Human Face"

contrast equal 100

Fig21. Shows the Face after Increasing the Brightness

In Brightness , the less negative value becomes the more, it will affects the face detection in an image, see fig16 and fig17.

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