

Skin Detection in Luminance Images using Threshold Technique

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Abstract—With the development of the chromatic skin color detection models, the threshold value is a useful and forceful element to discriminate between the skin and non-skin pixels. This paper reports an experimental investigation, which aims at using different threshold values to classify the human skin. The chromatic skin color model was used to model skin color in the r-g chromaticity space. This model based on testing database containing many of human images. It has been found that the threshold value is an important tool for increasing the human skin regions detected in color images containing luminance

Keywords—Skin chrominance models, Pixels classification, Skin detection.

I. INTRODUCTION

IT has been reached by researchers that skin color models can be used for detecting human skin in various computer vision applications. (Yang *et al*, 1998) suggested a real-time face tracker using an adaptive skin color model. They modeled the rg-chromaticities of skin as a 2D Gaussian distribution. (Jones and Rehg, 1999) compared a Bayesian approach to a mixture of Gaussian in RGB space. This model includes nearly 1 billion labeled training pixels obtained from Internet. (Jedynak *et al*, 2002) considered a sequence of three models for skin detection built from a large collection of labeled images. Each model is a maximum entropy model with respect to constraints concerning distributions. Several models were proposed for detecting human skin in various lighting conditions. (Soriano *et al*, 2000) presented a face tracking method that is adaptive to varying illumination color. (Storring and Andersen, 1999) proposed model for detecting human skin under changing lighting conditions. (Cho *et al*, 2001) presented a new skin color filter that is useful and capable of finding skin regions in images and adaptively adjust its threshold. While (Caetano *et al*, 2003) compared between single model and several Gaussian mixture models used to improve skin detection.

This paper presents the impact of adjusting the threshold value in the chromatic skin color model for improving skin detection in images that contain luminance.

II. CHROMATIC MODEL

The various color spaces can be easily converted to a RGB representation, A triple $[r,g,b]$ doesn't represent only color but also brightness, due to that property it was used to represent skin color in there chromatic color space . Chromatic colors, which represented by (Yang *et al*, 2002) known as “pure” color in the absence of brightness, are defined by:

$$r = \frac{R}{R+G+B}, \quad g = \frac{G}{R+G+B} \quad (1)$$

A color histogram is the distribution of colors in the color space; figure (1- a) shows a various people's images, and corresponding areas for histogram analysis are shown in Fig (1-b). The histograms of the skin color region selected are illustrated in figure (1-c).

The color distribution of the skin color is clustered in small area of the chromatic color space. Figure 2 shows a skin color distribution of fifty people of different races with different skin colors in the chromatic color space.

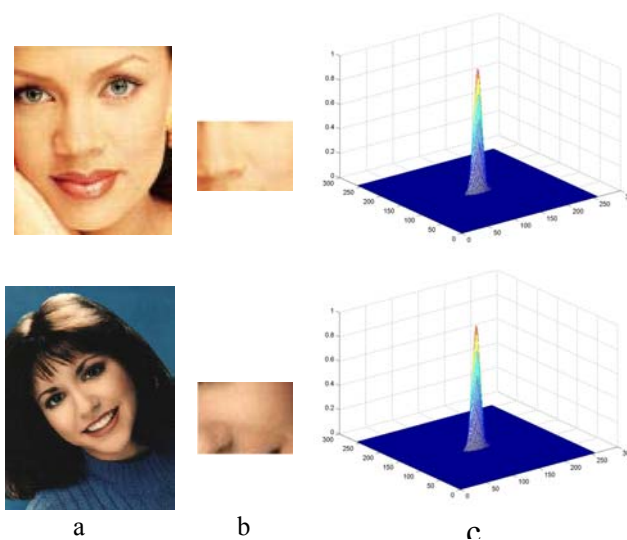


Fig.1 various people images (A), Skin area For histogram analysis (B), histograms for Selected skin area (C).

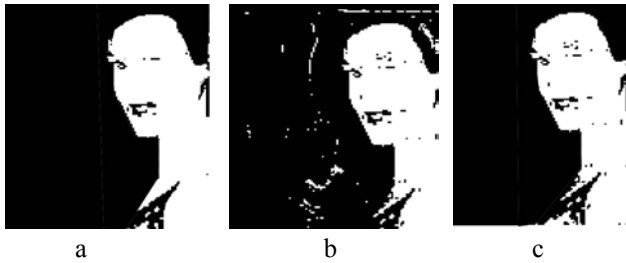


Figure 3: first column the original image, real skin pixels (a), real and non-real skin pixels detected (b), and the real skin pixels detected (c).

After the estimated optimal threshold value is applied on the ICSC model, the testing image is segmented into skin and non-skin pixels, figure (7-b). The number of skin and non-skin pixels is determined; the skin pixels detected is called the real and non-real skin pixels detected, from this segmented-image, the number of the real skin-pixels is computed, and illustrated in figure (7-c).

By using one of the image processing programs, the real skin pixels of the input (image under test) is determined. See figure (7-a).

Table (2) shows the number of the skin and non-skin pixels for all the above cases

Real skin pixels (A)	128557
Real and non-real skin pixels detected (B)	128509
Real skin pixels detected (C)	125945
TP	0.979
FP	0.019
FN	0.02

Table 1: Number of real and non-real skin pixels detected

From the images and table above, the TP and FN were estimated. The TP is recognized from the proportion of pixels detected as skin which are really skin pixels to the total number of real skin pixels, while the FN identified from the proportion of pixels detected as skin which are not real skin pixels to the total number of real skin pixels [23]. It is worth mentioning that these TP and FN values prove the formula(5).

The obtained optimal threshold value is equal to 0.1. This optimal value is estimated after a conducted test for the training data with different threshold values.

The following paragraph will show the difference in the results that occur when the threshold value is 0.7.

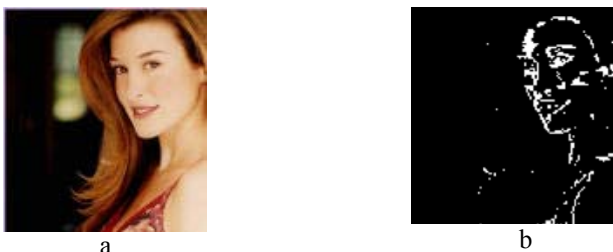


Figure 4: left the original image, right the segmented image

From the figure (4), it can be noted clearly that the segmented-images is used when threshold value is (0.7). Besides the area of skin-detected is too small, in a way it leads to a high false detection rate.

IV. RESULTS AND DISCUSSION

The Chromatic Skin Color model was applied to a set of testing data of people images download from the Internet belonging to people of different races contain luminance, The model applied with two threshold values, the threshold values are 0.1 and 0.01.

The figure below shows some images contain luminance. The first column is representing the original images (images under test). Figure (5-b) shows the skin regions detected when the threshold value is 0.1 .In the figure (5-c) the skin regions detected are belongs to the threshold value 0.01.

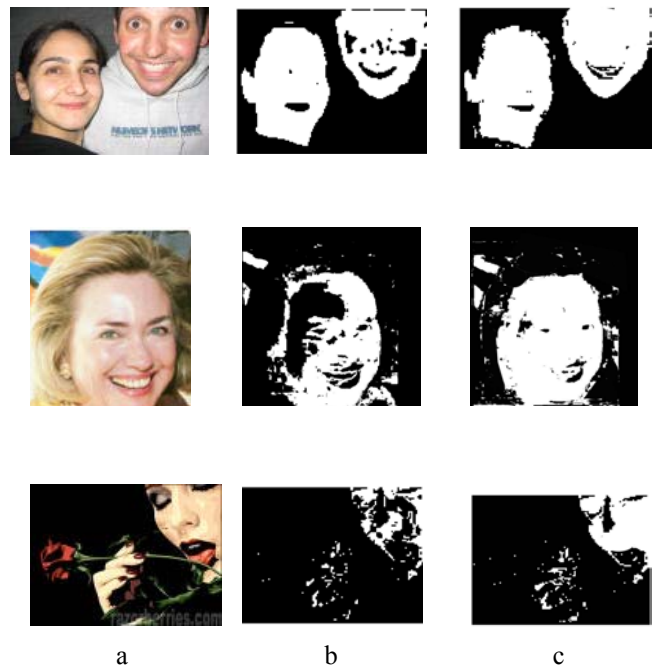


Fig.5 Shows the original images (a), Skin region detected when threshold value 0.1 (b), the skin regions detected when the threshold value is 0.01(c).

These results confirm that the threshold value is very important tool for improving the skin region detected in color images. The figure (6) shows the detection rates of the images when the threshold value is 0.1. The detection rates ranging from 85% to 95%. Figure (7) shows the detection rates of the regions detected would increase, when the threshold value 0.01 was selected.

