International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 05 | May -2019 ISSN: 2395-0126

Study of Skin Color Detection

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Abstract: *This paper given a comparative study of human complexion detection HSV and YCbCr color area. complexion detection is that the method of separation between skin and non-skin pixels. it's tough to develop uniform methodology for the segmentation or detection of human skin detection as a result of the color tone of human skin is drastically varied for individuals from one region to a different. Literature survey shows that there's a range of color area is applied for the complexion detection. RGB color area isn't most popular for color based mostly detection and color analysis owing to combining of color(chrominance) and intensity (luminance) data and its non-uniform characteristics. luminosity and Hue based mostly approaches discriminate color and intensity data even beneath uneven illumination conditions. Experimental result shows the potency of YCbCr color area for the segmentation and detection of complexion in color pictures.*

Keywords - Skin color; Segmentation; Color space; Luminance; Hue; Saturation; Value; Chrominance

I. INTRODUCTION

The objective of the skin detection is to search out skin regions in a picture. complexion detection is that the method of separation between skin and non-skin pixels. it's the initial step to search out the regions that doubtless have human faces and limbs in a picture. it's troublesome to develop uniform technique for the segmentation or detection of human skin detection due to color tone of human skin is drastically varied for folks from one region to a different. as an example, the complexion tone of Europeans is totally different from Africans or Asians. The detection and segmentation of skin regions in a picture is wide utilized in several applications like classification and retrieval of color pictures in transmission applications, video police investigation, human motion observance, human pc interaction, digital cameras, face detection and recognition, conference, hand detection, gesture detection. There are 2 forms of skin detection, either component or region based mostly. in the pixel based skin detection, each pixel is classed as either skin or non-skin one by one from its neighbor. The skin detection in this color fall during this class. within the region based skin detection, the skin pixels are spatially organized to enhance the performance. This technique needs further info like intensity, texture is needed. within the complexion detection method, it's

necessary to think about the subsequent factors. (i) the excellence or separation of skin and non-skin pixels within the image. (ii) The device for capture the image. For an equivalent image, {different totally different completely different} cameras have different output. (iii) whether or not illumination varies drastically within the image? (iv) Skin tones vary from one person to others. (v) Movement of object degrades the standard of image because of blurring of colors. (vi) Shadows and lightness contains a important role to alter the color of the image. (vii) the color house used for the detection or segmentation. The following sections of this paper are organized as follows. The section a pair of in short describes the construct of complexion detection victimization totally different color house. the tactic for the detection of complexion is given within the section three. The section four describes the experimental results and at last the section five concludes the paper.

II. COLOR SPACE FOR SKIN COLOR DETECTION

Color information is represented as three or four different color components in a mathematical model called color space. Different color models are used for different applications such as computer graphics, image processing, TV broadcasting, and computer vision [2] [3] [4]. For color detection there are different color space available. They are as follow: perceptually uniform color space (CIEXYZ, CIELAB, and CIELUV), Luminance based color space (YCBCr, YIQ, and YUV), RGB based color space (RGB, normalized RGB), and Hue Based color space (HSI, HSV, and HSL). The skin color detection based on RGB color space is explained in [4][5]. Color based detection and color analysis is not done by using RGB color space because of mixing of color (chrominance) and intensity (luminance) information and its non-uniform characteristics. Process of normalization is used for the transformation of RGB to normalized RGB. The component 'b' does not contain any valuable information. If there is any memory constraint, this component can be omitted. In normalized RGB color space, the color information can easily be separated from the intensity information.

But under uneven illuminations, normalized RGB is not considered for color detection or segmentation. The skin color detection which is based on normalized RGB color space is explained in [6][7][8][9].

$$r = \frac{R}{R+G+B} \tag{1}$$

$$g = \frac{G}{R+G+B} \tag{2}$$

$$b = \frac{B}{R+G+B} \tag{3}$$

$$r + g + b = 1 \tag{4}$$

Under uneven illumination conditions, discriminate color and intensity information by Luminance and Hue based approaches. The conversion from RGB to HSI or HSV is expensive. Moreover, if there is a more fluctuation in the values of hue and saturation, small and large intensities pixels are not considered. In the case of YCbCr color space, transformation and efficient separation of color and intensity information is very much easy as compared to HSI or HSV. HSV based skin color detection and segmentation is described in [7][10] [11][12][13][14]. The transformation of color images in RGB color space is converted into HSV color space using (5)(6)(7).

$$H = arccos\frac{\frac{1}{2}(2R-G-B)}{\sqrt{(R-G)^2-(R-B)(G-B)}} \tag{5}$$

$$S = \frac{max(R,G,B)-min(R,G,B)}{max(R,G,B)} \tag{6}$$

$$V = max(R,G,B) \tag{7}$$

The skin color detection and segmentation using YCbCr color space is explained in [7] [15] [16] [17]. In computer based applications, the full range of 8-bit is used, without providing space for header and footer. Usually, this full-range color format is used for JPEG images. The conversion between YCbCr color space and RGB color space and is described by the following equations:

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 0.279 & 0.504 & 0.098 \\ -0.148 & -0.291 & 0.439 \\ 0.439 & -0.368 & -0.071 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{8}$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1.164 & 0.000 & 1.596 \\ 1.164 & -0.392 & -0.813 \\ 1.164 & 2.017 & 0.000 \end{bmatrix} \begin{bmatrix} Y-16 \\ Cb-128 \\ Cr-128 \end{bmatrix} \tag{9}$$

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 0 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ -0.169 & -0.331 & 0.500 \\ 0.500 & -0.419 & -0.081 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{10}$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1.000 & 0.000 & 1.400 \\ 1.000 & -0.343 & -0.711 \\ 1.000 & 1.765 & 0.000 \end{bmatrix} \begin{bmatrix} Y \\ Cb-128 \\ Cr-128 \end{bmatrix} \tag{11}$$

Neural network based self-organizing maps can be applied for the efficient detection of skin regions. This is explained by [19]. Automatic segmentation of human face in the complex background scene is explained in [16]. The human face detection in color images under complex background and uncontrolled illumination in YCbCr and HSV color space is given in [17].

III. METHODOLOGY

Skin detection using YCbCr color space and HSV is based on the threshold value of the individual component of corresponding color space. Due to device dependent nature and non-uniform, RGB color space not widely used for analysis of colors. This section describes the methodology used for the skin detection in color images using two different color spaces.

IV. EXPERIMENTAL RESULT

Figure 4 gives the experimental result of HSV color space based on skin detection. The input image in RGB color space is metamorphose into HSV color space. Hence the applied image is split into three different parts as hue, saturation and value based on color (chrominance) and intensity information. This is shown in Fig. 1(b)-1(d) and their corresponding histogram is shown in Fig 2. From the histogram, corresponding threshold value is determined.

International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 05 | May -2019 ISSN: 2395-0126

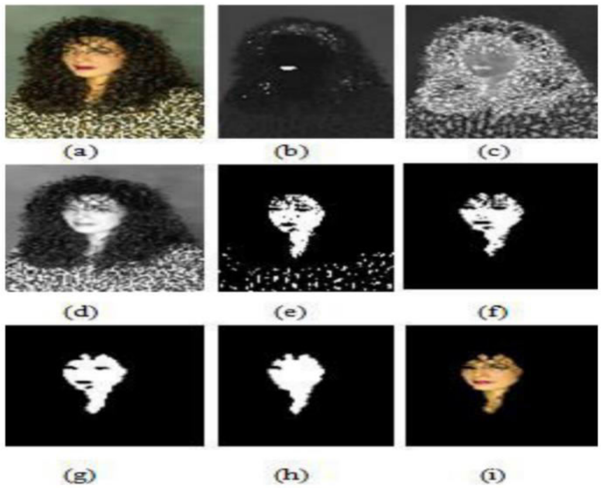

Fig.1. Skin detection using HSV color space (a) test image1 (b) hue image (c) saturation image (d) value image (e) masking of skin pixels (f) threshold image (g) smoothened image (h) regions filled image (i) output image.

Masking of skin pixels is shown in Fig. 1(e). Then threshold is applied for the masked image. The threshold value for this image is selected as 150. The pixel values less than the threshold are removed. Finally, the output image is obtained after smoothening and filtering. The same procedure is repeated for the test image 2 and 3 shown in Fig 3(a) and 5(a) respectively. The threshold value for these two images is 500 to remove the non-skin pixels due to its complex background.

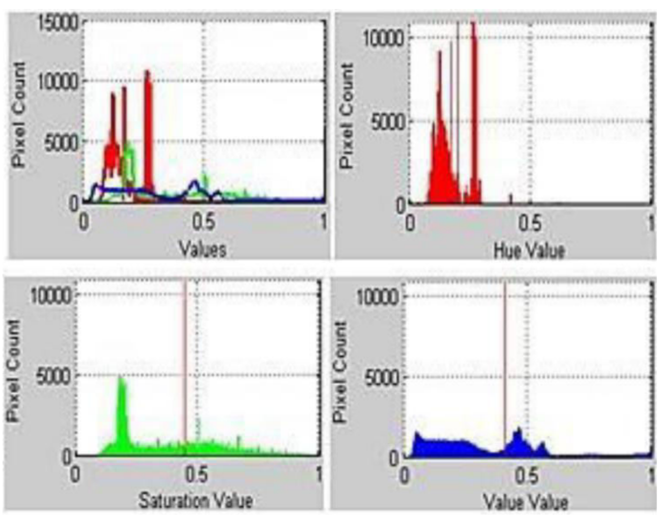

Fig.2. Histogram and threshold value for hue, saturation and value. The vertical red line indicates threshold value.

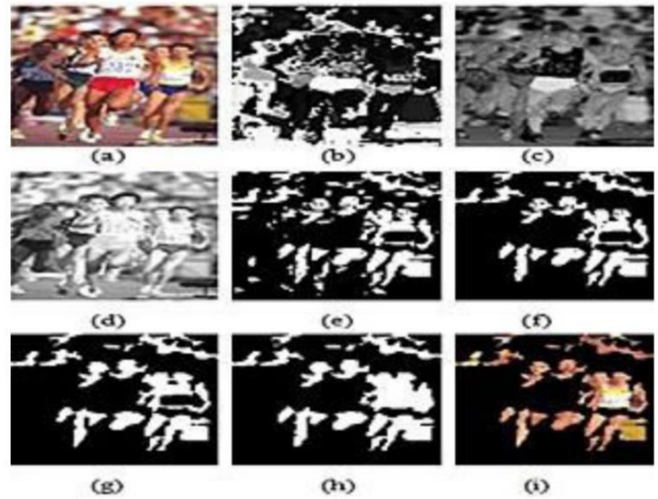

Fig.3. Experimental result on test image 2 (a) test image (b) hue image (c) saturation image (d) value image (e) masking of skin pixels (f) threshold image (g) smoothened image (h) regions filled image (i) output image.

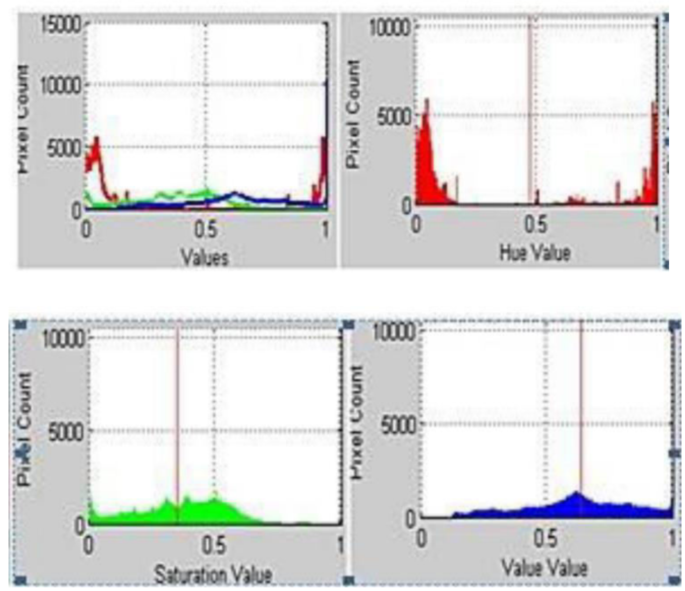

Fig.4. Histogram and threshold value for hue, saturation and value. The vertical red line indicates threshold value.

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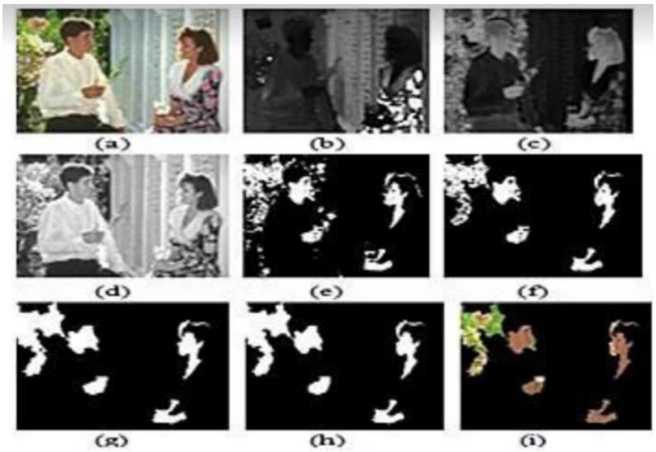

Fig.5. Experimental result on test image 3 (a) test image (b) hue image (c) saturation image (d) value image (e) masking of skin pixels (f) threshold image (g) smoothened image (h) regions filled image (i) output image.

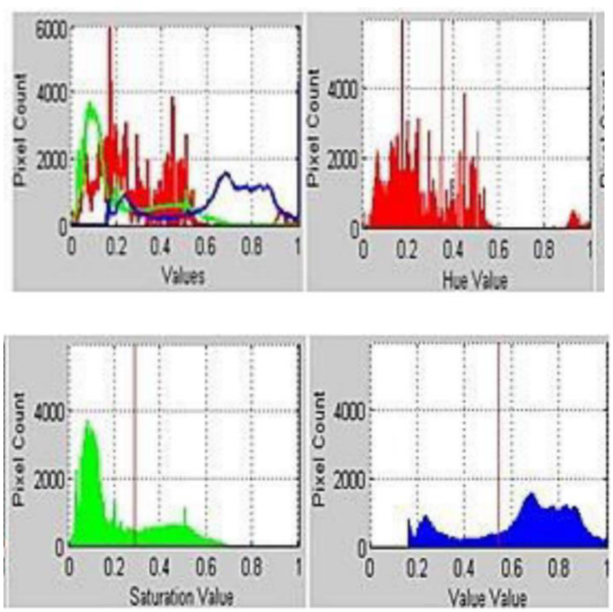

Fig.6. Histogram and threshold value for hue, saturation and value. The vertical red line indicates threshold value.

The experimental result of the skin detection using YCbCr color space is shown in figure 7. This method is purely based on the threshold value of three different components. The result image is comprised of intensity component (Y) and chrominance components (Cb and Cr), when an RGB color image is transformed into YCbCr color image. In our experiment, threshold is applied for chrominance components only as Cr > 150 && Cr <200 &&Cb> 100 &&Cb< 150.

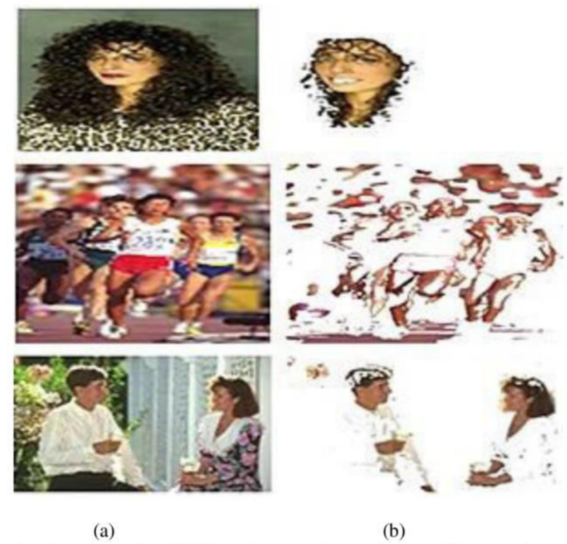

Fig.7. Skin color detection using YCbCr color space (a) test images (b) output images.

V. CONCLUSION

In this Paper detection and segmentation of skin pixels using HSV and YCbCr color space is explained. The selection of threshold value is used for the result of HSV and YCbCr color space based skin color detection. These approaches discriminate color and intensity information even under uneven illumination conditions. The transformation of color images from RGB to HSV consumes too much time. In this, Cartesian coordinate system is converted into polar coordinate system. The HSV based detection is best suited for simple images with uniform background. Moreover, pixels with small and large intensities are not considered if there is a lot fluctuation in the value of the color information (hue and saturation). Transformation and efficient separation of color and intensity information is easy as compared to HSI or HSV in the case of YCbCr color space. This color space is effective and efficient for the separation of image pixels in terms of color in color images. So for the complex color images with uneven illumination YCbCr color space is applied.

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