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Detection and Identification of Human Skin Diseases Using CIElab Values

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Abstract: The purpose of a human skin detection method is to distinguish image portions between skin and non-skin regions. Many existing approaches in the literature are based on features that explore information of color, shape and texture in the images. Variety of color spaces has been used in skin detection with the aim of finding a color space where the skin color is invariant to illumination conditions. In this paper we are discussed the RGB and CIELab color space model for detecting the human skin. In this paper we also discussed the conversion of RGB values to CIELab values for Human skin Detection and identification of skin diseases using the color of the skin.

Keyword: Human skin, Skin Disease, RGB, CILAB.

I. INTRODUCTION

Detection of human skin has applications in several areas, such as face recognition, gesture analysis, nudity detection, and person tracking, content-based image retrieval, among others. The presence of people in an image or a video scene can be evidenced by finding skin regions. Automatic skin detection is a challenging task, especially under varying illumination and partial occlusions [1].

Skin Detection and Color Spaces

The appearance of skin is formed by a combination of blood (red) and melanin (brown, yellow). Therefore, the human skin color does not fall randomly in a given color space, but clustered at a small area in the color space. But it is not the same for all the color spaces. Variety of color spaces has been used in skin detection with the aim of finding a color space where the skin color is invariant to illumination conditions. The choice of the color spaces affects the shape of the skin class, which affects the detection process. Here, RGB and CIELAB color spaces, which are typically used in skin detection, are briefly described.

II. COLOR MODEL

A. RGB Color Model:

The RGB color space consists of the three additive primaries: red, green and blue. Spectral components of these colors combine additively to produce a resultant color. The RGB model is represented by a 3-dimensional cube with red green and blue at the corners on each axis as shown in Figure 1. Black is at the origin. White is at the opposite end of the cube [2]. The gray scale follows the line from black to white. In a 24-bit color graphics system with 8 bits per color channel, red is (255, 0, 0). On the color cube, it is (1, 0, 0). The RGB model simplifies the design of computer graphics systems but is not ideal for all applications. The red, green and blue color components are highly correlated. This makes it difficult to execute some image processing algorithms. Many processing techniques, such as histogram equalization, work on the intensity component of an image only.

B. RGB Color Space and Skin Detection:

RGB color space is the most commonly used color space in digital images. It encodes colors as an additive combination of three primary colors: red(R), green (G) and blue (B). RGB Color space is often visualized as a 3D cube where R, G and B are the three perpendicular axes [5, 9]. One main advantage of the RGB space is its simplicity. However, it is not perceptually uniform, which means distances in the RGB space do not linearly correspond to human perception. In addition, RGB color space does not separate luminance and chrominance, and the R, G, and B components are highly correlated. The luminance of a given RGB pixel is a linear combination of the R, G, and B values. Therefore, changing the luminance of a given skin patch affects all the R, G, and B components. In other words, the location of a given skin patch in the RGB color cube will change based on the intensity of the illumination under which such patch was imaged. This results in a much stretched skin color cluster in the RGB color cube [3].

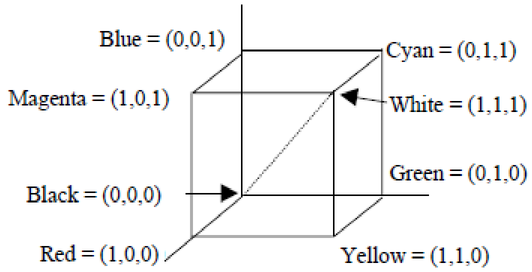

Fig. 1 RGB color cube

C. CIELAB Color Model:

In 1976, the CIE (international commission on illumination) recommended the CIEL*a*b* or CIELAB, color scale for use. It provides a standard, approximately uniform color scale which could be used by everyone so that the color values can be easily compared [4, 7]. This color model is designed to approximate perceptually uniform Color spaces (UCSs). It is related to the RGB color space through a highly nonlinear transformation. It has three axes in it two are color axes and the third is lightness.

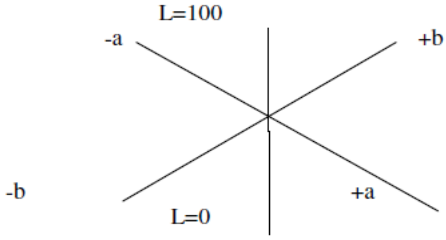

Fig 2. CIELAB Color Model

The L*a*b* model is a three-dimensional model; it can only be represented properly in a three-dimensional space. The solution to convert digital images from the RGB space to the L*a*b* color space is given by the following formula.

$$\begin{pmatrix} L^* = 116\, f(Y/Y_n) - 16 \\ a^* = 500[f(X/X_n) - f(Y/Y_n)] \\ b^* = 200[f(Y/Y_n) - f(Z/Z_n)] \end{pmatrix}$$

X, Y, Z, Xn, Yn, and Zn are the coordinates of CIEXYZ color space. The solution to convert digital images from the RGB space to the CIEXYZ color space is as the following formula.

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} 0.608 & 0.174 & 0.201 \\ 0.299 & 0.587 & 0.114 \\ 0.000 & 0.066 & 1.117 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix}$$

Xn, Yn, and Zn are respectively corresponding to the white value of the parameter. Where L indicates lightness, +a and –a indicates amount of green and red color respectively, +b and –b indicates amount of yellow and blue color respectively. Here maximum value of L is 100 which represent a perfect reflecting diffuser (white color) and the minimum value for L is 0 which represents black color [5]. Axes a and b do not have any specific numerical value. Cie-L*ab is defined by lightness and the color-opponent dimensions a and b, which are based on the compressed Xyz color space coordinates. Lab is particularly notable for its use in delta-e calculations [3, 11].

R´G´B´ are nonlinearly distorted values for each channel in physical tristimulus systems like CIE, NTSC or working spaces like sRGB or AdobeRGB (98). RGB are undistorted values which are linearly related to CIEXYZ. Each RGB system has a white point (w) [6]. G2.4xrGeneric gamma correction, G=2.2, C=R, G, B

$$C = C'^{G}$$

sRGB gamma correction, C=R,G,B

$$C = \begin{cases} C'/12.92 & \text{if } C' \le 0.03928 \\ ((0.055 + C')/1.055)^{2.4} & \text{else} \end{cases}$$

RGB to XYZ (same white point D65)

$$X = C_{xr} R$$

RGB to XYZ (new white point D50, Bradford correction)

$$X = B C_{xr} R$$

XYZ to L*a*b* (reference white X_n)

$$X_1 = \frac{X}{X_n}$$

$$Y_1 = \frac{Y}{Y_n}$$

$$Z_1 = \frac{Z}{Z_n}$$

$$X_1 = \begin{cases} X_1^{1/3} & \text{if } X_1 > 0.008856 \\ 7.787\,X_1 + 16/116 & \text{else} \end{cases}$$

$$Y_1 = \begin{cases} Y_1^{1/3} & \text{if } Y_1 > 0.008856 \\ 7.787\,Y_1 + 16/116 & \text{else} \end{cases}$$

$$Z_1 = \begin{cases} Z_1^{1/3} & \text{if } Z_1 > 0.008856 \\ 7.787\,Z_1 + 16/116 & \text{else} \end{cases}$$

$$L^* = 116\,Y_1 - 16$$

$$a^* = 500\,(X_1 - Y_1)$$

$$b^* = 200\,(Y_1 - Z_1)$$

The following table shows the RGB values converted in to corresponding CIE-L*ab values.

Table 1.RGB converted to CIE-L*ab values

RGB Values		Converted CIE-L*ab Values	
R	1	L	0.274175924239664
G	1	A	0.0000373013175764
B	1	B	-0.0000738057445437

Fig. 3. Flower A: L* = 52.99 a* = 8.82 b* = 54.53 Flower B: L* = 29.00 a* = 52.48 b* = 22.23

III. SKIN DISEASES AND SKIN

Human skin color ranges in variety from the darkest brown to the lightest pinkish-white hues. The actual skin color of different humans is affected by many substances, although the single most important substance is the pigment melanin. Melanin is produced within the skin in cells called melanocytes and it is the main determinant of the skin color of darker-skinned humans. The skin color of people with light skin is determined mainly by the bluish-white connective tissue under the dermis and by the hemoglobin circulating in the veins of the dermis. The red color underlying the skin becomes more visible, especially in the face, when, as consequence of physical exercise or the stimulation of the nervous system (anger, fear), arterioles dilate. The color is not the same all over and may include shades of brown or black, or sometimes with patches of pink, red, white, or blue[7,8].

Human Skin color is like as white, Blackish, yellowish, brown, pink etc. Those skin having cancer diseases that skin is like brown colors, burned skin is look like dark blue and infected skin color is look like pinks. Unusual moles, sores, lumps, blemishes, markings, or changes in the way an area of the skin looks or feels may be a sign of melanoma or another type of skin cancer, or a warning that it might occur. A normal mole is usually an evenly colored brown, tan, or black spot on the skin. The mole is changing in size, shape, or color.

Diabetes can affect every part of the body, including the skin. Many people with diabetes will have a skin disorder caused or affected by diabetes at some time in their lives. In some cases, skin problems can be the first sign that a person has diabetes [9, 10].

In some cases, people with diabetes develop skin conditions that can affect anyone [11]. Examples of these conditions include bacterial infections, fungal infections, and itching. However, people with diabetes also are more prone to getting certain conditions. These include diabetic dermopathy, necrobiosis lipoidica diabeticorum, and eruptive xanthomatosis [12, 13].

Fig. 4 skin color and Diseases

IV. COLORS BY NAME

We are calculating CIE Lab values corresponding RGB values as shown in Table below. These values are used for selecting the particular colors by name like as Black, white, Red Green etc. So this table is also used for not only detecting the skin but also used for identify the diseases of the skin depending upon the color of the skin [14, 15,]

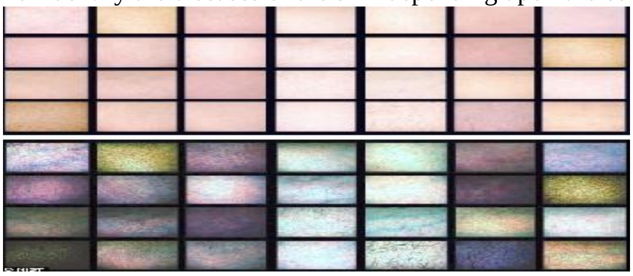

Fig. 5 Human skin Samples and colors

Table 2. Color and its CIELab values.

Color Name	RGB Values	CIE-L*ab Values
Black	0 0 0	0 0 0
White	255 255 255	100 0.01 -0.01
Floral White	255 250 240	98.4 -0.03 5.37
Ghost White	248 248 255	97.76 1.25 -3.36
Snow	255 250 250	98.64 1.66 0.58
Red	255 0 0	53.23 80.11 67.22
Dark Red	139 0 0	28.08 51.01 41.29
Purple	128 0 128	29.78 58.94 -36.5
Violet	238 130 238	69.69 56.37 -36.82
Green	0 128 0	46.23 -51.7 49.9
Lime	0 255 0	87.74 -86.18 83.18
Lime Green	50 205 50	72.61 -67.13 61.44
Pale Green	152 251 152	90.75 -48.3 38.52
Sea Green	46 139 87	51.54 -39.71 20.05
Blue	0 0 255	32.3 79.2 -107.86
Royal Blue	65 105 225	47.83 26.27 -65.27
Sky Blue	135 206 235	79.21 -14.83 -21.28
Slate Blue	106 90 205	45.34 36.05 -57.78
Yellow	255 255 0	97.14 -21.56 94.48
Light yellow	255 255 224	99.28 -5.1 14.83
Violet	238 130 238	69.69 56.37 -36.82
Brown	165 42 42	37.52 49.7 30.54
Deep Pink	255 20 147	55.95 84.56 -5.71
Magenta	255 0 255	60.32 98.25 -60.84
Dark Violet	148 0 211	39.58 76.34 -70.38
Dark Orange	255 140 0	69.48 36.83 75.49
Gold	255 215 0	86.93 -1.92 87.14
Hot Pink	255 105 180	65.48 64.25 -10.66

V. CONCLUSION

In this paper we are discussed the RGB and CIELab color space model for detecting the human skin. RGB color space model is not support to detecting the accurate color of skin. Human skin is most complicated mixture of different colors. We recommend the CIElab color space model for detecting the human skin. CIElab color values give the most accurate result compare to the RGB values. So we are recommending the CIElab values for Human skin Detection and identification of skin diseases using the color of the skin.

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