Color skin modeling

- A preliminary step of face detection, face tracking , gesture analysis, content-based image retrieval (CBIR) systems and to various human computer interaction domains

- the skin color in an image is sensitive to various factors such as Illumination, Camera characteristics, Ethnicity, Individual characteristics, other factors

- skin detection can be viewed as a two class problem: skin-pixel vs. non-skin-pixel classification.
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- The primary steps for skin detection in an image using color information are (1) to represent the image pixels in a suitable color space, (2) to model the skin and non-skin pixels using a suitable distribution and (3) to classify the modeled distributions

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# A survey of skin-color modeling and detection methods

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**Abstract**

Skin detection plays an important role in a wide range of image processing applications ranging from face detection, face tracking, gesture analysis, content-based image retrieval systems and to various human computer interaction domains. Recently, skin detection methodologies based on skin-color information as a cue has gained much attention as skin-color provides computationally effective yet, robust information against rotations, scaling and partial occlusions. Skin detection using color information can be a challenging task as the skin appearance in images is affected by various factors such as illumination, background, camera characteristics, and ethnicity. Numerous techniques are presented in literature for skin detection using color. In this paper, we provide a critical up-to-date review of the various skin modeling and classification strategies based on color information in the visual spectrum. The review is divided into three different categories: first, we present the various color spaces used for skin modeling and detection. Second, we present different skin modeling and classification approaches. However, many of these works are limited in performance due to real-world conditions such as illumination

- Skin-color distribution is modeled primarily either by histogram models or by single/Gaussian mixture models
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- Many of the existing skin detection strategies are not effective when the illumination conditions vary rapidly. To cope with changes in illumination conditions and viewing environment only few skin detection strategies use color constancy and dynamic adaptation techniques.
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- In dynamic adaptation techniques, the existing skin-color model is transformed to the changing illumination conditions. An up-to-date review of such illumination adaptation approaches for skin detection is also presented.

Basic Color Spaces (RGB, normalized RGB,CIE–XYZ)
RGB
r+g+b=1
the differences in skin-color pixels due to lighting conditions and due to ethnicity can be greatly reduced in normalized RGB (rgb) space. Also, the skin-color clusters in rgb space have relatively lower variance than the corresponding clusters in RGB and hence are shown to be good for skin-color modeling and detection [11,12].

The CIE (Commission
Internationale de l'Eclairage) system describes color as a luminance component Y, and two additional components X and Z.

Perceptual color spaces (HSI, HSV, HSL, TSL)
The HSV space defines color as Hue—the property of a color that varies in passing from red to green, Saturation—the property of a color that varies in passing from red to pink, Brightness (also called Intensity or Lightness or Value)—the property that varies in passing
from black to white. The transformation of RGB to HSV is invariant to high intensity at white lights, ambient light and surface orientations relative to the light source and hence, can form a very good choice for skin detection methods.

Orthogonal color spaces (YCbCr, YIQ, YUV, YES)
Perceptually uniform color spaces (CIE-Lab and CIE-Luv)

Skin-color classification
From a classification point of view, skin-color detection can be viewed as a two class problem: skin-pixel vs. non-skin-pixel classification

de-fine skin-color cluster decision boundaries for different color space components

. The I component includes colors from orange to cyan.All the pixel values in the range, RI= [0,50] are described as skin pixels in this approach. Pitas [29,49] used fixed range values on the HS color space. The pixel values in the range RH= [0,50] and RS= [0.23,0.68] are defined as skin pixels

The threshold values
in the range Rr= [0.36,0.465], Rg= [0.28,0.363], RH= [0,50], RS=[0.20,0.68] and RV=[0.1.0] are used for discriminating skin and non-skin pixels.

Histogram model with naı¨ve bayes classifiers
The histogram bin counts are converted into probability distribution, P(c) as follows:
P(c) =count(c)/T
where count(c) gives the count in the histogram bin associated with color c and T is the total count obtained by summing the counts in all the histogram bins.