Volume 4, Issue 7, July 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Skin Segmentation Using YCBCR and RGB Color Models

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Abstract— Face detection is one of the challenging problems in image processing. This report proposes a novel technique for detecting faces in color images using skin color model algorithm combined with skin likely-hood, skin Segmentation, Morphological operation and Template matching. Color images with skin color in the chromatic and pure color space YCrCb, which separates luminance and chrominance components. A Gaussian probability density is estimated from skin samples, collected from different ethnic groups, via the maximum-likelihood criterion. Adaptive thresholding for segmentation to localize the faces within the detected skin regions. Further, mathematical morphological operators are used to remove noisy regions and fill holes in the skin-color region, so that candidate human face regions can be extracted. These systems can achieve high detection accuracy, high detection speed and reduce the false detecting rate. The two methodology used for the Skin Segmentation is YCbCr and RGB Model. In YCbCr model both the skin colour and texture of the image can be used to identify the particular object in the image,where as in RGB model only the skin color has to be used for identification of the person.Hence the YCbCr model is better than the RGB model . From our analysis we conclude that the new approach in modeling skin color can achieve good detection success rate. The algorithm gives computationally a very efficient as well as an accurate approach for skin detection. The performance of different color space may be dependent on the method used to model the color for skin pixel.

Keywords—Gaussian probability, YCrCb,RGB Model

I. Introduction

In recent years, there has been a growing research interest in the problem of segmenting skin regions in color images. Human Skin segmentation aims to locate skin regions in an unconstrained input image. It plays an important role in many computer vision tasks such as face detection, face tracking, hand segmentation for gesture analysis, and filtering of objectionable Web images. In these tasks, results of skin segmentation enable subsequent object detection to focus on reduced skin regions instead of the entire input image. To this end, skin segmentation is a very effective tool because skin regions can be located fast with usually minimal amount of added computation.Many machine vision applications for recognizing people and their activities have been developed, such as surveillance system, security and control system, human computer interaction, etc. One important task in those systems is face detection, which is usually used as a front-end process to detect and localize a human face from images. Many researchers have proposed various techniques to detect human faces from images. In YCrCb color space was used to detect faces in the context of video sequences. A two-dimensional Cr-Cb histogram was employed for separating a facial region from the back-ground and a region-growing technique was applied on the remaining area. Finally faces are detected by ellipse matching and using criteria based on face's characteristics under a normal illumination condition, the skin color falls into a small region on the CbCr plane, and the luminance (Y) is uncorrelated with respect to the CbCr. Thus, a pixel is classified as skin-like if its chrominance value falls into the small region defined in CbCr plane, and the luminance (Y) falls into the interval defined empirically. Many different methods for discriminating between skin and non-skin pixels are available in the literature. These can be grouped in three types of skin modeling: parametric, nonparametric, and explicit skin cluster definition methods. The Gaussian parametric models assume that skin color distribution can be modeled by an elliptical Gaussian joint probability density function. Nonparametric methods estimate skin color distribution from the histogram of the training data without deriving an explicit model of skin color model. The simplest, and often applied, methods build what is called an "explicit skin cluster" classifier which expressly defines the boundaries of the skin cluster in certain color spaces. The underlying hypothesis of methods based on explicit skin clustering is that skin pixels exhibit similar color coordinates in an appropriately chosen color space. These binary methods are very popular as they are easy to implement and do not require a training phase. The main difficulty in achieving high skin recognition rates with the smallest possible number of false positive pixels is that of defining accurate cluster boundaries through simple, often heuristically chosen decision rules.

OBJECTIVE

To study and implement the Bayesian algorithm for Skin Segmentation.Implementation of RGB model and YCbCr model for identification of the Skin and Non Skin color.Use the color models for skin colors differentiation in a given input image.

II. LITERATURE SURVEY

Most existing skin segmentation approaches are based on skin color. Skin regions are detected by looking for pixels that have skin colors. In this paper, we propose an algorithm that combines color and edge information to segment skin regions in color images. Among many face detection algorithms, the method based on skin color model has been widely used for its convenient use, simple performance and high detection speed. When there are a large number of objects similar to skin color. So we need to utilize the other features of human face to further verify. It helps to detect faces from different environmental variations [Son Lam Phung, Abdesselam Bouzerdoum, and Douglas Chai]. The first stage of the proposed scheme consists in locating the potential face areas in the image, using skin chrominance information, given that such an information strongly reduces the search space. [Christophe Garcia and Georgios Tziritas, "Face Detection Using Quantized Skin Color Regions Merging and Wavelet Packet Analysis]. Before proceeding with skin color classification, a color quantization of the original image is performed, in order to improve skin color segmentation by homogenizing the image regions. Gaussian models were employed to build the skin color models based on YCrCb or normalized RGB color spaces. The skin-likelihood image is obtained from the model and will be a grayscale image whose gray values represent the likelihood of the pixel belonging to skin. Then, skin regions and non-skin regions are obtained by thresholding the skin-likelihood image.

BAYESIAN MODE

The Bayesian model can be described as follows. Let c be a color vector in a given color space. Let p(c|skin) and p(c|nonskin) be the class-conditional probability density functions (pdfs) of the skin color and nonskin color classes, respectively. The color c is classified as skin color if:

$$\frac{p(\mathbf{c} \mid skin)}{p(\mathbf{c} \mid nonskin)} \geq \theta \,,$$

where θ is a threshold.. The theoretical value of θ that minimizes the classification cost is determined by a priori probabilities P (skin) and P (nonskin) of the two classes. Here for YCbCr its thresholding is
$(77 \leq C_B \leq 127 \text{ AND } 133 \leq C_R \leq 173)$

YCBCR COLOR MODEL

.A skin color map is derived and used on the chrominance components of the input image to detect pixels that appear to be skin The algorithm then employs a set of regularization processes to reinforce those regions of skin-color pixels that are more likely to belong to the facial regions. We u se only their color segmentation step here. Working in the YCbCr space the authors find that the ranges of Cb and Cr most representatives for the skin-color reference map were:
$77 \leq C_B \leq 127 \text{ AND } 133 \leq C_R \leq 173$

RGB COLOR MODEL

The RGB color space and deal with the illumination conditions under which the image is captured where the condition of uniform daylight illumination done

UNIFORM DAYLIGHT ILLUMINATION:

R > 95 , G > 40 , B > 20
MAX {R, G, B} – MIN {R, G, B} < 15
|R - G| > 15, R > G, R > B

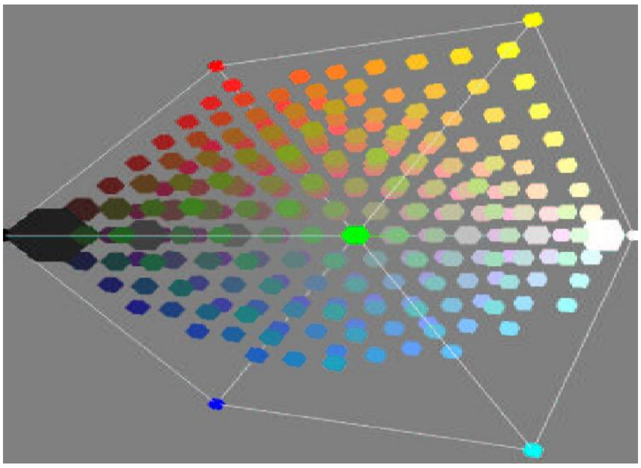

Fig 2.1 : Represents General Color Model-RGB

III. ADVANTAGES OF SKIN COLOR MODELS

A human skin color model is used to decide if a color is a skin or nonskin color. Major requirements of a skin color models are listed below :

[1] Very low false rejection rate at low false detection rate:
Skin color detection is first step in skin segmentation, therefore it is imperative that almost all skin colors are detected while keeping the false detection rate low. False detections can be handled later when more a priori knowledge about the object of interest (i.e. face, hand) is available.

[2] Detection of different skin color types:
There are many skin color types, ranging from whitish and yellowish to Blackish and brownish, which must be all classified in one class, skin color.

[3] Handling of ambiguity between skin and non skin colors:
There are many objects in the environment that have the same color as skin. In these instances, even a human observer cannot determine if a particular color is from a skin or nonskin region without taking into account contextual information. An effective skin color model should address this ambiguity between skin and nonskin colors.

IV. DESIGN AND SPECIFICATION

I] Skin segmentation algorithm using YCbCr model:

1: Read color human image.
2: Convert the image to YCbCr color space.
3: Classify the colors in color space models using by using tresholding
4: The resulted image is a clustered image.
5: Label every pixel in the image using the results from color models.

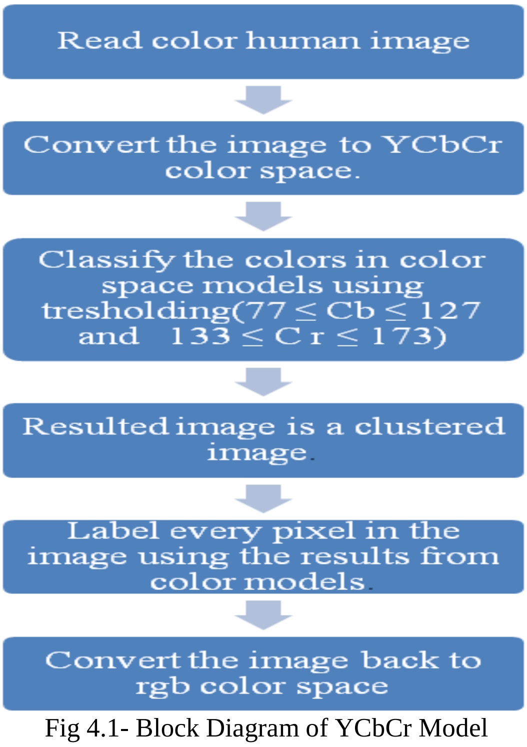

Fig 4.1- Block Diagram of YCbCr Model

II] Skin segmentation algorithm using RGB model:
Step-1: Read the image

Step-2: Separate the color indexed image into its RGB components

Step-3: Convert the RGB matrices into a gray-scale intensity image

Step-4: R, G, B is classified as skin if:

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

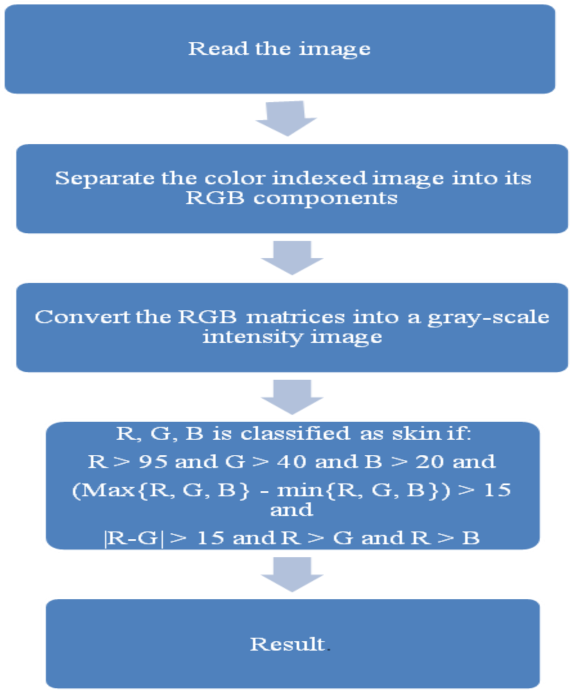

Fig.4.2 Block Diagram of RGB Model

Tresholding values used:

<u>For YCbCr Model:</u>

$77 \leq Cb \leq 127$ and $133 \leq Cr \leq 173$

3.5.2 For RGB Model:

<u>Uniform daylight illumination:</u>

R > 95 , G > 40 , B > 20

Max {R, G, B} – Min {R, G, B} < 15

|R - G| > 15, R > G, R > B

V. RESULTS ACHIEVED

1) Image output using YCbCr Model:

The algorithm used is the YCbCr algorithm in which it separates the Skin part from non skin part. Here are the three examples i.e. an African girl (for texture), Cricket team (group) and animal. It not only detects human skin but also animal skin.

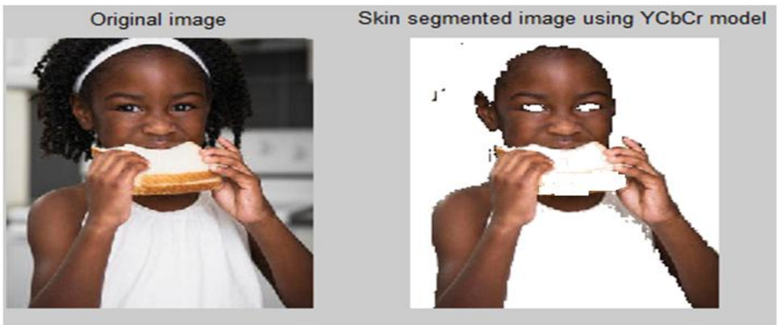

Fig 5.1:- Output Image using YCbCr (African Girl)

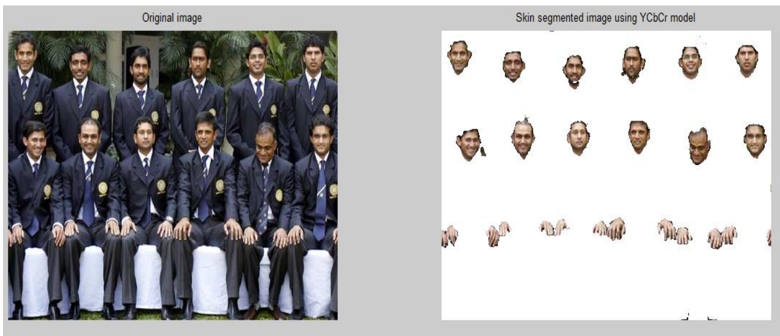

Fig 5.2: Output Image using YCbCr Model (Indian Cricket Team)

Fig 5.3:- Output Image using YCbCr Model (Animal Skin)

In this methodology it is found that it is possible to identify a particular individual in the group or animal present. It is also possible to identify the objects from the texture information available in the output image

2) Image output using RGB Model:

The same images were analysed using RGB algorithm in which it separates the Skin part from non skin part. Here are the three examples i.e. an African girl (for texture), Cricket team (group) and animal. It not only detects human skin but also animal skin.

Fig 5.4:- Output Image using RGB (African Girl)

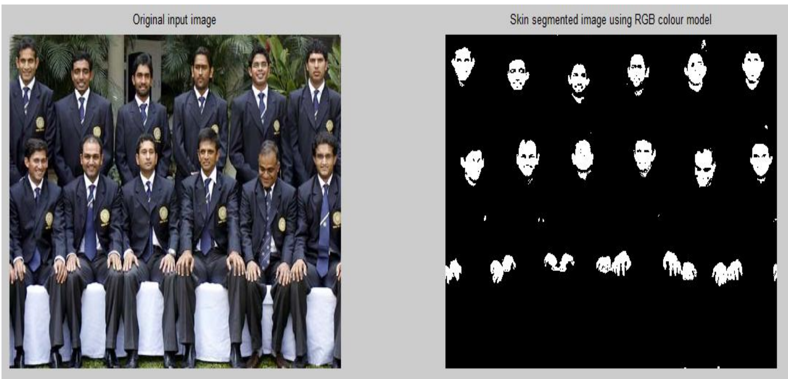

Fig 5.5:- Output Image using RGB Model (Indian Cricket Team)

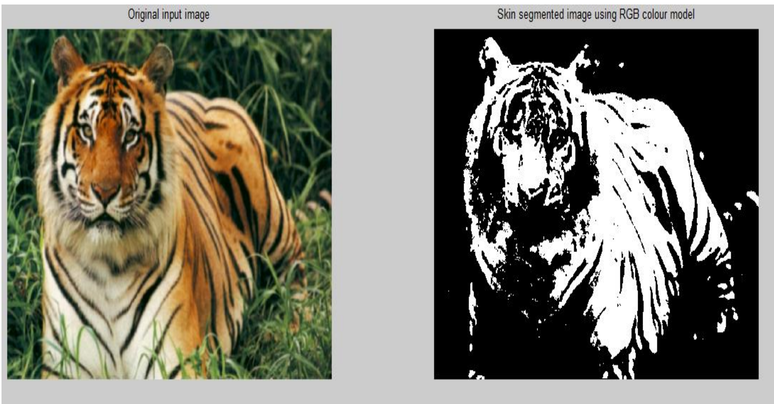

Fig 5.6:- Output Image using RGB Model (Animal Skin)

In RGB methodology it is possible to identify the particular individual in the group or the animal present. However this model can detects the skin area but the output image doesn't give any information on the texture of the image .

Comparing both the Models, it is suggested that with YCbCr model both the skin colour and texture of the image can be used to identify the particular object in the image, where as in RGB model only the skin color has to be used for identification of the person. Hence the YCbCr model is better than the RGB model .

VI. CONCLUSION AND FUTURE WORK

CONCLUSION:

The present segmentation algorithm for face detection in color images is developed. From our analysis we conclude that the new approach in modeling skin color can achieve good detection success rate.

The algorithm gives computationally a very efficient as well as an accurate approach for skin detection which may be applied in real time. The skin colors form a separate cluster in the RGB color space. Hence skin color can be used for skin segmentation in images and videos. Comparing both the Models, it is suggested that with YCbCr model both the skin colour and texture of the image can be used to identify the particular object in the image, where as in RGB model only the skin color has to be used for identification of the person. Hence the YCbCr model is better than the RGB model . The performance of different color space may be dependent on the method used to model the color for skin pixel.

FUTURE WORK:

In future work, it is possible to improve the method for detecting multiple faces under various orientations, incorporate video images for face detection and tracking to increase the performance and implement the same on real hardware system.

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