A Morphology based Approach for Human Skin Detection in Color Image

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A reliable skin detection method that is adaptable to different human skin colors and illumination is very essential for human skin detection. Today's many skin detection methods are available in literature but they are not able to cope with variety of skin colors. Several image processing and computer vision approaches have been developed for human skin detection. In this work we propose a mathematical morphology based YCbCr method which given better performance as compare to other HSV, YCbCr color spaces. This method is simple and efficient. The experimental result shows that the proposed method can achieve satisfactory performance in real time applications.

Keywords: Skin Detection, Image Processing, Morphology, YCbCr Method, CbCr Color Space.

1. INTRODUCTION

Human skin detection plays an important role in wide range of image processing and computer vision applications [1]. 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 [1,2]. It is a preprocessing step in various fields such as hand detection and face detection, personal identification, security systems, human computer interaction, human pose modeling, video conferences, face recognition, intelligent video surveillances, medical diagnosis like skin cancer detection, naked people detection on internet and social networking sites for the sake of content filtering [2, 3]. In early application, skin detection was used to detect anchors in TV news videos for the sake of automatic annotation in video, archival, and retrieval [3]. In such an application, it is very crucial that the face and the hands of the anchor person are the largest skin-tone colored region in a given frame and typically, news programs are shot in indoor controlled environments with man-made background materials that contains skin-color object [3, 4].

Skin segmentation is a process of differentiating skin region from non skin region in color images [5]. Skin color is often used because it is invariant to orientation, size and gives an extra dimension compared to gray scale methods and fast to process [5, 6]. Skin detection is used to determine the presence and localization of a face, hand or other body parts in an image by distinguishing it from background of image or from all other

patterns present in an image [4, 6].

Skin detection system is never perfect and is not robust for dealing with some real-world problems. The main problems with the robustness of skin color detection are (i) it varies from person to person (ii) dependence on the illumination condition, and (iii) skin color is not unique. Skin detector transform a given pixel into an appropriate color space and then use a skin classifier to label the pixel whether it is a skin or a non-skin pixel [3, 6, 7]. In this paper, we propose an efficient method for skin color segmentation on color images. In the first step color image from input color space is converted to RGB color space and then converted into YCbCr. Single or multiple ranges of threshold values for each color space components are defined in such a way that the image pixel value fall within these predefined range(s) are selected as skin pixels [2]. Then we have applied morphological operations such as erosion to remove pixels from outside boundary or remove outliers and to separate skin region and non skin region.

2. COLOR SPACES

In literature different kinds of color spaces are available. Most of the research is based on RGB and YCbCr color space. The first step is to select a suitable color space which can easily differentiate between skin and non skin pixels [5,8]. This mainly affects the performance of skin detector and its sensitivity to change in illumination conditions.

2.1. RGB Color Space

RGB represents the default color space which is used for storing and representing digital images using linear or non-linear transformation of RGB, we can get any other color space. The color space transformation is mainly used to reduce the overlapping problem between skin and non-skin pixels [1, 5, 9]. The choice of appropriate color space is often guided by the skin detection methodology and the application. It is the most commonly used color space but is not ideal for all application.

Kovac *et al.* work within the RGB color space and deals with the illumination under which the image is captured [3]. Therefore we classify skin color by heuristic rule that takes into account two different conditions: uniform daylight and flash or lateral illumination [2,5,10].

The skin color is detected using following conditions at uniform daylight illumination [5]

$$R > 95, G > 40, B > 20$$

$$Max(R, G, B) – min(R, G, B) < 15 |R – G| > 15, R>G, R>B$$

And the skin color is detected using following conditions at flashlight or daylight lateral illumination [5]

$$R>220, G>210, B>170 |R-G|<=15, B<R, B<G$$

2.2. YCbCr Color Space

YCbCr is most commonly used model in digital video because it has the smallest overlap between the skin and non skin data in under various illumination conditions. It belongs to the family of television transmission color space. These color space separates. These color spaces separate RGB into luminance and chrominance information and are very useful in compression applications however the specification of colors is somewhat unintuitive. The YCbCr color space is commonly used in image processing as it separates the luminance, in Y component, form the chrominance described through Cb and Cr components [9,10]. The Cb and Cr components are used to characterize the skin color information. Chai and Ngan develop an algorithm for spatial distribution of human skin color. A skin color map is derived and used on chrominance component of input image to detect skin pixels. Then some rules are set to reinforce those regions of skin color pixels which are likely belong to the facial regions [5,9,11].The Cb and Cr components are most represented between the range given below. The range for the skin color reference map is: 77<=Cb<=127 and 133<=Cr<=173.

3. PROPOSED SKIN DETECTION ALGORITHM IN RGB AND YCbCr COLOR SPACE

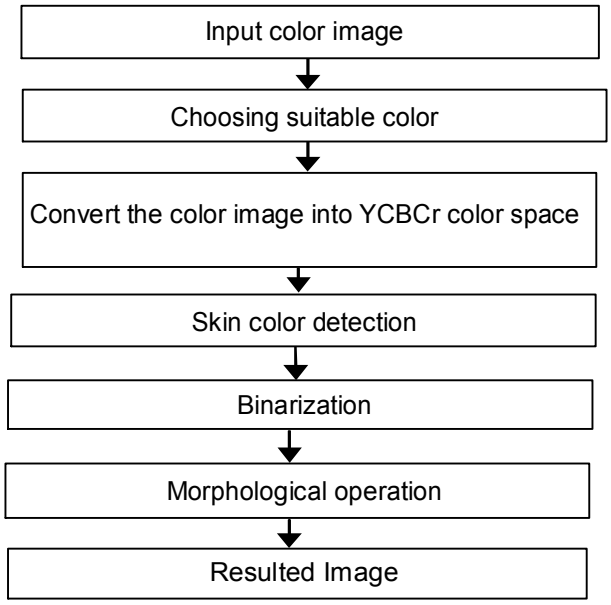

Fig. 1: Showing Block diagram of proposed skin detection algorithm.

This paper mainly focuses on the type of color model used to differentiate skin and non skin region in color images. Implementation of this research work is done with Matlab-2011

tool. As shown in Figure1 In the initial stage color images is taken as input from a database and then in the next step color balance operation is performed for better detection rate. Then we perform some morphological operations such as erosion to remove noise pixels or outliers while preserving the structural properties to be used for further processing. Finally we sort all pixels region-wise using matlab tool regionprops (Parameters) and then select the skin-region from binarized image.

4. EXPERIMENTAL RESULTS

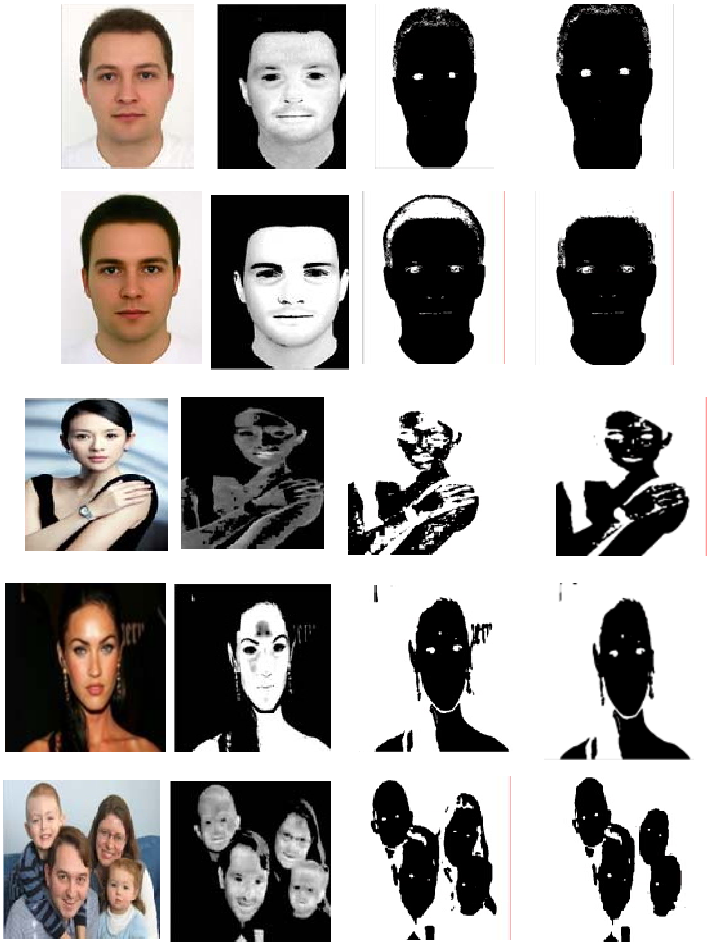

Fig. 2: Skin segmentation results with RGB color space, YCbCr color space and Proposed method. (a) Original image (b) result using RGB color space (c) result using YCbCr color space (d) result using proposed method.

We assume that the skin color is determined mostly by its chrominance components Cb and Cr so the luminance component depends only on lightning condition which is based on [1] and skin color of various human individuals and also human skin color types is the same in its chrominance components. The difference is only according to the variation in luminance parameters. This implicates that there is no need to trace luminance component probability function in skin color detection in YCbCr color space.

Main advantage of this method is that it has smallest overlap between skin and non skin region, simplicity and less computational cost. The method described in this paper finds it difficult to differentiate when background color of image is similar to skin color.

5. CONCLUSION

In this paper, the skin detection method is based on RGB and YCbCr color space model and has been proposed a morphology based method for automatic detection of human skin in image(s). As exhibited in experiments, the proposed method performs better in terms of accuracy and information. The skin detection system in this paper deals with the detection of skin region in YCbCr and RGB color space. In case of YCbCr luminance is not taken into binary segmentation and noise removal methods. Skin detection can also be used as an efficient preprocessing filter to find potential skin regions in color images prior to applying more computationally expensive face or hand detectors. The proposed method produces good results as compare to others as shown in Figure 2. Our future work is focused on building a better preprocessing method for color skin detection in video.

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