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Skin Tone Detection and Segmentation in Spatial Domain

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Abstract. Human skin tone detection and segmentation play an important role in many fields like computer sciences, medical and electrical etc. Skin detection is an important process in many computer vision algorithms. It usually is a process that starts with a pixel-level, and that involves a pre-process of color distance transformation followed by a classification process. This research deals with human skin tone detection and segmentation by using spatial filters. There are various techniques used for human skin detection and segmentation in the spatial domain as well as in frequency domain. The human skin color varies from person to person and region to region, therefore, it is difficult to introduce a specific method for human skin detection and segmentation. As through skin detection, we can make the two segments of the digital image, "skin segment" and "non-skin segment". In this work, we determine if the color space transformation does bring those benefits by measuring four the capability of being separated measurements on a large dataset of 805 images with different skin tones and illumination. This article also present the value of skin segment part in percentage. Different researchers used different type of methods and color models but the proposed method here is "without Global image enhancement" (GIE) by using HSV color model for the skin detection and segmentation in spatial domain.

Keywords. Human skin tone detection; GIE; skin segmentation; HSV; Morphology

1. Introduction

Skin detection is becoming an attractive topic for researchers from past few years just because it plays a very important role in the field of image and signal processing [1-10]. Human skin detection and segmentation is the first step which we can take for the face detection. Skin detection is also helpful in the medical field [20-30]. Human skin detection and segmentation plays an important role in face tracking, gesture reorganization, face tracking, emotional computing, biometric surveillance, face attribute classification and is also used to filter the adult data on internet[31-45]. The main challenge task in skin detection is to create the recognition sturdy to the large variance in appearance of skin that may occur, like in color and shape, effects of one celestial body obscures another, intensity, color, location of light source, etc. The process of skin detection generally is a pixel level process involving a pre-process of colorspace transformation and morphological operation [46-55]. Imaging noise can appear as spot of skin like color, and also many other objects like wood, leather and some clothes are often confused as skin. In general, human skin is characterized by a combination of red skin and scales and feathers(yellow, brown) and there is somewhat a range of hue for skin and saturation that represents the skin-like pixels [56-60]. Most of the work done in the area of skin detection have been concentrated on detecting skins of European, Black or East Asian ethnicities, whereas, less focus has been concentrated to detect East Asian (i.e. Pakistani, Indian) skins [7, 61-70].

2.Related works :

Generally, in skin tone detection there are several descriptors proposed to represent the skin with respect to their colour. Various algorithms have been designed to extract the color and features for the image. Recent papers on the performance evaluation of color space transformation for skin detection are summarized.Zarit et al [8].Five colorspaces were considered to measure the performance of skin detection methods.[9].Tint saturation Luminance (TSL) performed the best followed by normalized Red green (rg) and CIE-xy in Tp and FP rate in the human face detection. The performances of skin detection methods were quantitatively assessed in [10].

3.Proposed methodology

In this section, framework of the proposed system and its constituents will be discussed in detail,illustrating the concept of retrieving the concept of skin detection.First we will take the the RGB original image as a input and transform to the hue saturation and intensity (HSV) for the purpose of colorspace.The pixel value of the hue is different and the pixel of the hue is different and similarly the value pixel is different means all the values of the images is different from one another.After transform the image, the values of the hue,saturation and value is recombine for the purpose of the morphological operation. Follwoing, HSV image we operate the morphological operation.Morphological operation are those operation in which the dilation and erosion are occurs.Morphology is a broad set of image processing operations that process images based on shapes.Morphological operation apply a structuring element to an input image ,creating an output image of the same size.In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image.so,after applying the morphological operation on the image it will give the two result the first result is in the form of opening result of the image and the second result is in the form of closing result. closing as an important operator from the field of image processing,closing is similar in some ways to vacation in that it to enlarge the boundaries of foreground bright regions in an image and shrink background color holes in such region,but it is less destructive of the original boundary shape.while opening image the basic effect is that it like the erosion in that it to remove some of the foreground(bright) pixels from the edges or regions of foreground pixels.However it is less destructive than erosion in general. After the opening and closing result images.it will transform the red,green and blue skin images.The similarity is determined using the Euclidean distance between these images.The pixel of all images is different from one another.All the images have different values.we separate the skin pixels from the opening and the closing result therefore we will transform that images into red,green and blue.After the red, green and blue we will get the skinny images which is clear from all other image and will get the skinny image.Thr proposed framework is is illustrated in fig 1.

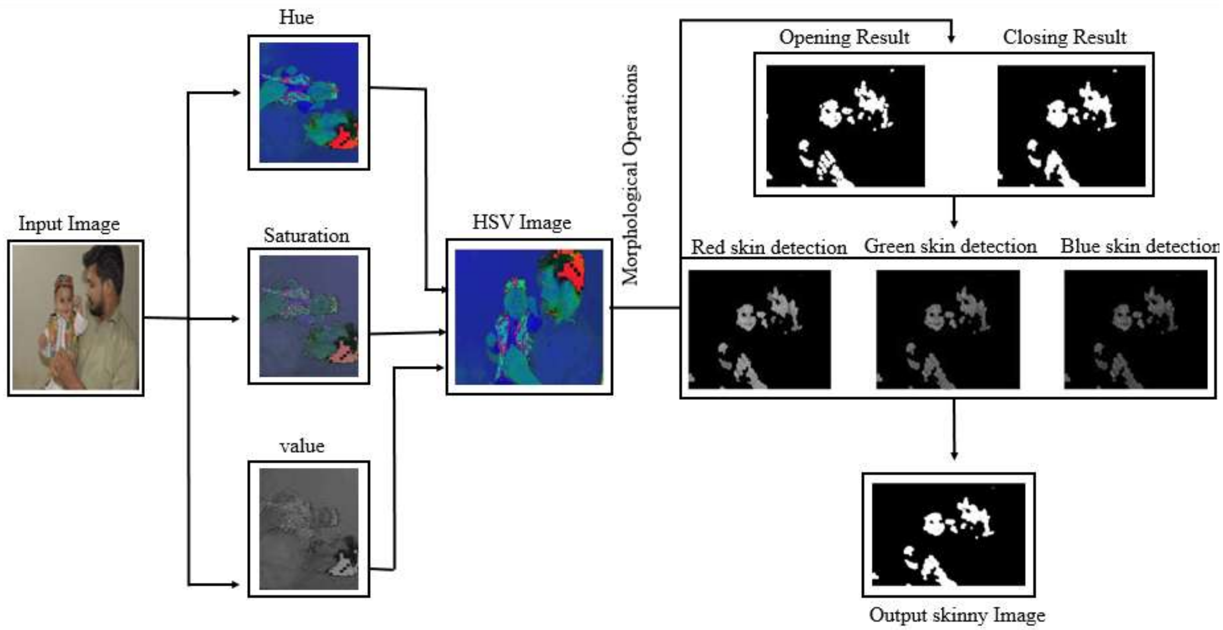

Figure 1: The proposed framework

3.1 Algorithm:

One of the simplest features used for the human face detection problem is the skin color information. A simple and relatively efficient algorithm is HSV algorithm. The algorithm is restricted in several aspects.it can only be applied to color images. We detect the skin in this article by using Hue- Saturation – Value (HSV) algorithms . We apply this algorithm on original Red Green Blue (RGB) image without using any equalization. We can detect the skin in 4 steps:

1. Read an image
2. Convert into HSV
3. Perform morphological operations on it
4. Detect a skin and show the results.

3.2 Color Features Extraction:

Due to the central role of color in the human visual perception system, color features can play a significant role in searching visually similar images. There exist several color spaces, which are specific representation of color an images. Each color model has their own characteristics and his own features. The HSV color model is closer to human perceptual understanding of colors as it decouples chromatic components from achromatic components and allows us to identify pure colors.[11, 12]

Journal of Engineering Technology

Volume 7, Special Issue (Internet of Things),Oct. 2018, PP. 118-129

RESEARCH ARTICLE -ENGINEERNG TECHNOLOGY ASEE

3.3 Read an image

On the very first step, select an RGB image. For this purpose, Matlab provides us with the built-in functions of imread() and imshow(). For this purpose the First command which is used is imread() to acquire our desired image then, to show the image by using imshow() command. The result is shown in the figure. Heres the algorithm converts the RGB to HSV R,G,B values are divided by 255 to change the range from 0..255 to 0..1:

R' = R/255

G' = G/255

B' = B/255

Cmax = max(R', G', B')

Cmin = min(R', G', B')

Δ = Cmax - Cmin

Figure 2. Original Image

2.2 Convert into HSV

Color vision can be processed using RGB color space or HSV color space. RGB color space describes colors in terms of the amount of red, green, and blue present. HSV color space describes colors in terms of the Hue, Saturation, and Value. In situations where color description plays an integral role, the HSV color model is often preferred over the RGB model. The HSV model describes colors similarly to how the human eye tends to perceive color. RGB defines color in terms of a combination of primary colors, whereas, HSV describes color using more familiar comparisons such as color, vibrancy and brightness. In this step, convert our RBG image into HSV color model. RGB color model is not suitable for human skin detection because of its non-uniform characteristics. HSV values vary from image to image so the HSV values of this image are:

(HSV(:,:,1)>=1.58 | HSV(:,:,1)<=1.05)&(HSV(:,:,2)>=0.29 & HSV(:,:,2)<=0.50)&(HSV(:,:,3)>=.29 | HSV(:,:,3)<=0.48);

The results are shown in figure 2.

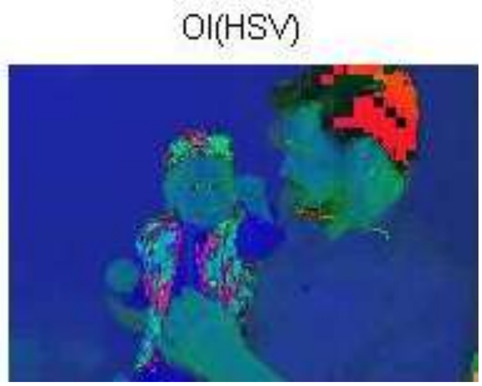

Figure 3: Original image in RGB & HSV domain

2.3 Perform Morphological Operations

Morphology is a technique of image processing based on the shape and size of the neighborhood [7]. The pixels value of the output image after the morphological operation is based on the neighbouring pixels of the input image [13]. The morphological operations are performed by using the spatial filters [14]. Matlab provides us different types of morphological operations but for this work, we only need two types of morphological operations and these are:

- Morphological opening
- Morphological closing

Opening and closing are two important operators from mathematical morphology. They are both derived from the fundamental operations of erosion and dilation. Like those operators, they are normally applied to binary images, although there are also grey level versions. The basic effect of an opening is somewhat like erosion in that it tends to remove some of the foreground (bright) pixels from the edges of regions of foreground pixels. However, it is less destructive than erosion in general. As with other morphological operators, the exact operation is determined by a structuring element. The effect of the operator is to preserve foreground regions that have a similar shape to this structuring element, or that can completely contain the structuring element while eliminating all other regions of foreground pixels. How it works it is very simple Very simply, an opening is defined as an erosion followed by a dilation using the same structuring element for both operations. See the sections on erosion and dilation for details of the individual steps. The opening operator, therefore, requires two inputs: an image to be opened, and a structuring element. The gray level opening consists simply of a grey level erosion followed by a grey level dilution. Opening is the dual of closing, i.e. opening the foreground pixels with a particular structuring element is equivalent to closing the background pixels with the same element.

Journal of Engineering Technology

Volume 7, Special Issue (Internet of Things),Oct. 2018, PP. 118-129

RESEARCH ARTICLE -ENGINEERNG TECHNOLOGY ASEE

While closing is also played an important role in the image field. Closing is an important operator from the field of mathematical morphology. Like its dual operator opening, it can be derived from the fundamental operations of erosion and dilation. Like those operators, it is normally applied to binary images, although there are grey level versions. Closing is similar in some ways to dilation in that it tends to enlarge the boundaries of foreground (bright) regions in an image (and shrink background color holes in such regions), but it is less destructive of the original boundary shape. As with other morphological operators, the exact operation is determined by structuring element. The effect of the operator is to preserve background regions that have a similar shape to this structuring element, or that can completely contain the structuring element while eliminating all other regions of background pixels.

These morphological operations are performed by using disk shape with radius 6. Morphological operations are performed using a different kind of spatial filters [15],[16] but in this article, the proposed types of spatial filters are min and max average filter. The results of morphological operations are shown in figure 3. Analysis of skin part on different steps of the proposed method is shown in table 1. Table 1 shows that in start skin part is 16.1 % but when we perform morphological opening it is reduced to 9.6% and after closing it is enhanced to 10.2 %. This is the accurate result of the skin part. The value of the non-skin pixels is 289808 while the pixels of the skin pixels is 55792 while the total pixels of the non-skin pixels and the skin pixels is 345600.

Types of operation	Non-skin pixels	Skin pixels	Total pixels	Pixels in Percent
HSV	289808	55792	345600	16.1%
Morphological opening	312257	33343	345600	9.6%
Morphological closing	310069	35531	345600	10.2%

Table 1: Analysis of skin pixels

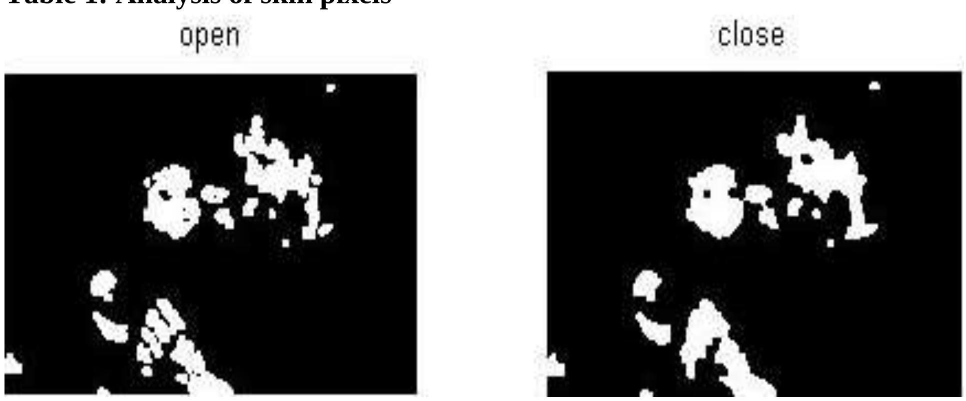

Figure 4: Morphological Operations

2.4 Detection of skin

As shown in figure 4 the skin tone is detected in three different component images red, green and blue. To get the final results we add these three images by using image and multiply built-in functions.

Journal of Engineering Technology

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RESEARCH ARTICLE -ENGINEERNG TECHNOLOGY ASEE

The resultant and final image is shown in figure 6.we know it is unusual to use RGB color space to detect skin instead of YCrCb, HSV, etc... but turned out it worked pretty well, fast and robust - especially with a monotone background. But the point is, how could the skin-toned region appear clearly on the background after subtracting the Grayscale from the Red plane (I = imsubtract(data(:,:,1), rgb2gray(data));)?

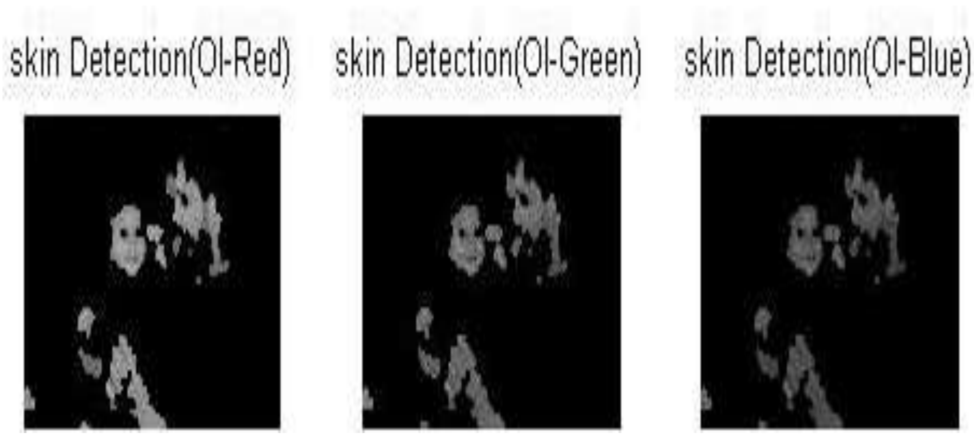

Figure 5. Skin Detection in RGB Components

Figure 6. Skin detection

3.Conclusion

Acquire an RGB image and apply HSV algorithm for skin detection on it. Following skin detection in HSV perform a morphological operation using min and max spatial filters on an image. Skin is detected in three different images as shown in figure 4. Simulate these red green blue component images by using “imadd” built-in function provided by MatlabR2011a, and the resultant image is shown in figure 5. As shown in Table 1 the resultant image has only 10.2% of the skin part. Skin regions do not have the same color values; even the closest skin color pixels within super pixels have different color values. Also, other skin-look-like objects exist. Hence, results can be further improved using texture information. This is left for our future work.

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