

Comparative Study for Two Color Spaces HSCbCr and YCbCr in Skin Color Detection

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Abstract

Most of the government as well as trade houses and defense organizations are taking advantage of biometric applications to arrange for advanced security solutions. Biometric security has already proven its significance. Even though, the application of Face recognition is used to ensure more security, safety, and prevention of deceitful act in biometric area. Face detection is one of the most valuable processes in the face recognition. Now-a-days, most of the researches are involved in the skin color based segmentation. There is no conclusion about which color space is best fit for skin color detection. This paper concentrates on the following points as 1) The input images are converted to the HSV and YCbCr model to collect the value of H,S,Cb,Cr. and check whether these values are satisfied with the threshold values. If the pixels are in the range of threshold then that pixels will be considered as skin region otherwise it is a non skin region. 2) It also gives the comparison result for both the color space as HSCbCr and YCbCr model. The defined algorithm has been tested on various real time frontal images and gets better results for HSCbCr than the YCbCr.

Keywords: Color spaces, Skin color detection, Morphological operation, HSCbCr algorithm, YCbCr algorithm and Face Detection

1. Introduction

Generally, the purpose of face detection is used to extract and locate the face in an image. The drawbacks of face detection are 1) the human face can be present or absent from a face. 2) Lighting effects from external conditions such as camera fading and shadows. 3) Pose 4) Orientation 5) Occlusions. [1-3] In the previous papers, they use the algorithm as Principal Component Analysis (PCA), geometric analysis, neural network, Linear Discriminator analysis, Skin color and Wavelet to rectify those problems which occur during face detection[6]. From the above stated algorithm, the skin color is the useful method for detecting face region.

We proposed an idea for skin color detection using HSCbCr which gives improved results than the existing approaches. And comparison of two color space such as HSCbCr and YCbCr model are also stated. This paper is organized as follows: color space selection describes about the selection of color space in Section 2. Section 3 denotes some of the morphological operations. In Section 4, it shows the details about face detection process. The proposed algorithm is explained in the Section 5. The Section 6 includes the results and discussion about the comparison of HSCbCr and YCbCr model. Conclusions and future enhancements are derived in Section 7.

2. Color space selection process

Colors play an important role for object detection, tracking and recognition, etc. [5]. Different color spaces have been proposed for skin based face detection such as RGB, normalized RGB, HSV, and YCbCr. Generally HSV and YCbCr color spaces are helped to retrieve from the intensity variations. Some of the previous works are included like [7], RGB, HSV, YUV color spaces are used in the application of face recognition and they get result as the complementary information and the accuracy of face recognition is affected by the color space. The paper [8] shows that the YCbCr, YIQ, CIE-La*b* are suited for the purpose of an FR (Face Recognition). In [8, 9, and 10], combining spectral components across different color spaces are useful for enhancing FR accuracy. Particularly, in [10] a new hybrid color space "RQCr" was proposed. From the paper [11], they propose three new color representations as uncorrelated color space, the independent color space and the discriminating color space. These color representations are effective for enhancing the FR performance. All the above previous works are used for improving the performance, accuracy of FR than the grayscale based FR.

In our approach, we consider the color space as “HSCbCr” i.e., The H and S component are taken from the HSV model and where the Cb and Cr are chosen from the YCbCr model. In addition, discussed about two color spaces and why it is important for skin color detection.

A. HSV Color Model:

The problem of RGB (Red, Green, and Blue) does not provide the correct information about skin color due to the problem of luminance effects. HSV provides color information as Hue (or color-depth), Saturation (or color-purity) and intensity of the Value (or color-brightness). Hue refers to the color of red, blue and yellow and has the range of 0 to 360. Saturation means purity of the color and takes the value from 0 to 100%. Value refers the brightness of the color and provides the achromatic idea of the color [4, 6]. From this color space, H and S will provide the necessary information about the skin color. The skin color pixel should satisfy the following condition

$$0 \leq H \leq 0.25; 0.15 \leq S \leq 0.9$$

B. YCbCr Color Model:

YPbPr and YCbCr are have the same color components like Luminance, blue minus Luminance, red minus Luminance but the YPbPr is the analog version where as YCbCr is the digital version. It has more advantage than the RGB & HSV model and extracts the skin portion of an image using chrominance values. The skin portion of an image should satisfy as follows

$$140 \leq Cr \leq 165; 140 \leq Cb \leq 195;$$

Even though it is a best approach, due to some reasons it gives low accuracy. So we collect four values from the two color space as H, S, Cb, and Cr and whether these values are satisfies the above conditions then the skin color segment being extracted from the image.

C. Basic flow of Face Detection:

The Face detection process is broadly classified into six parts. They are, 1. Input image which is acquired from the digital camera. 2. Skin detection process using HSCbCr model. 3. Morphological operation such as erosion, dilation etc., 4. Mask Creation using roipoly to create the binary mask 5. Image cropping is to crop the exact portion of a face and 6. The output image contains the part of a face region.

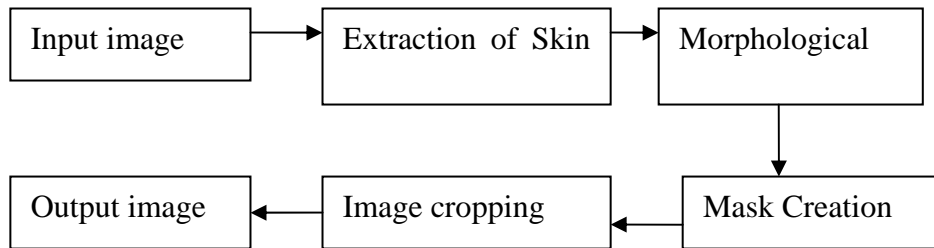


Figure 1 denotes the process of face detection

1. Skin Color Detection:

Skin Color Detection is the most important work in the application of Face Recognition. In this proposed work, we use HSCbCr to detect the skin portion of an image. The ranges for all the four values are discussed in the previous section. It works well when compared to the YCbCr model. The results of the HSCbCr and YCbCr are as follows.

HSCbCr images

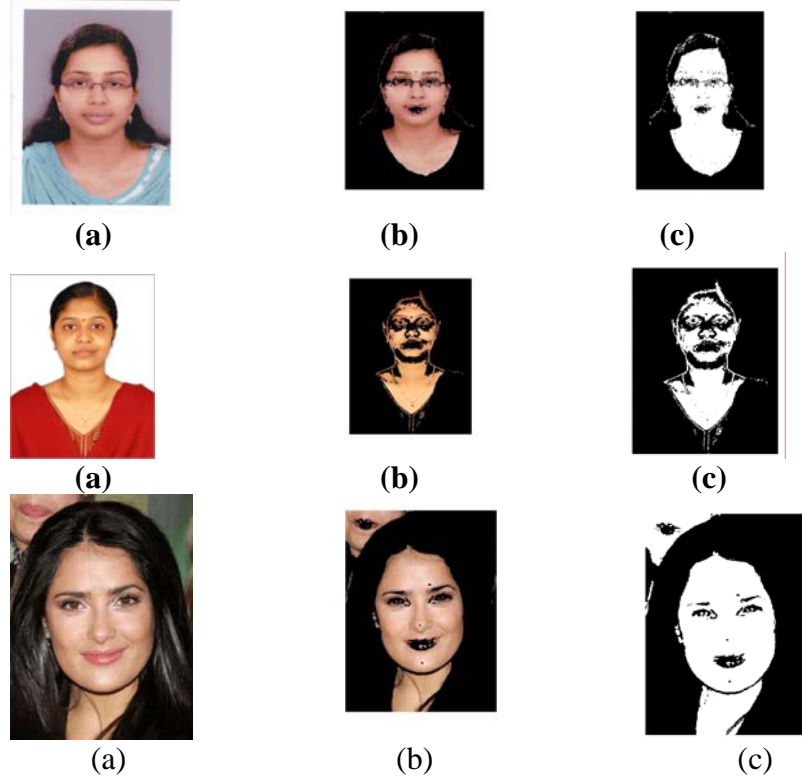


Figure 2: the results of the HSCbCr model. In this figure (a) represents original image, (b) represents HSCbCr image and finally (c) denotes the binarized image

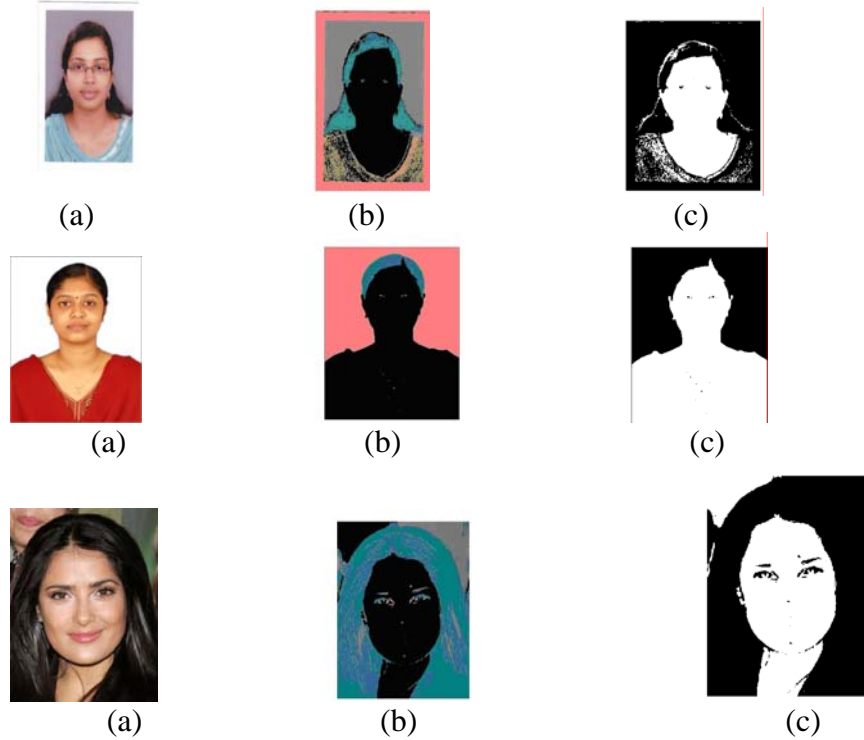
YCbCr images

Figure 3: the results of the YCbCr model. In this figure (a) represents original image, (b) represents YCbCr image and finally (c) denotes the binarized image

From the above figure, we can judge that the HSCbCr performance is better than the YCbCr performance. In YCbCr image, if the image has more red color then the result of the skin detection will be less where as the same image in HSCbCr gives the exact result.

2. Morphological Operation:

Morphology is a broad set of operations that process images based on shapes. The operations of morphological are erosion and dilation used to smooth the object boundary without changing their respective area. The purpose of using erosion and dilation is to improve the efficiency of face detection. The dilation process is to add pixels in the boundary of an object where as the erosion is used to remove the boundary pixel from an object. Adding or removing the pixel from an object is fully based on the size or shape of the Structuring element, which defines the neighborhood pixel. First the image is dilated and then eroded by using the same structuring element then this process is called closing operation. The opening operation performs eroded the image and then dilate the eroded

image.

HSCbCr images:

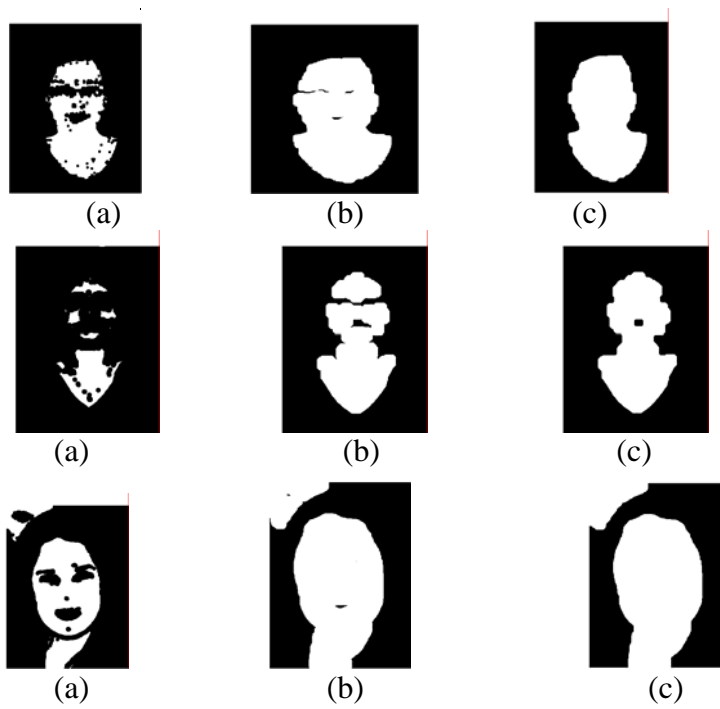
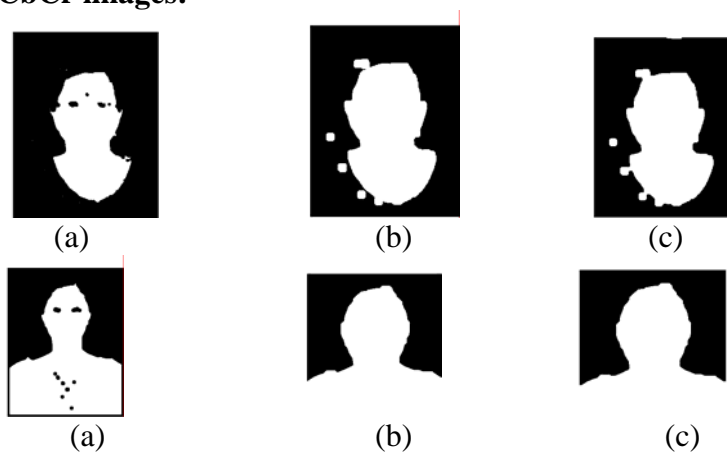


Figure 4: represents the morphological results for HSCbCr images such as a) Erosion b) dilation c) closing

YCbCr images:



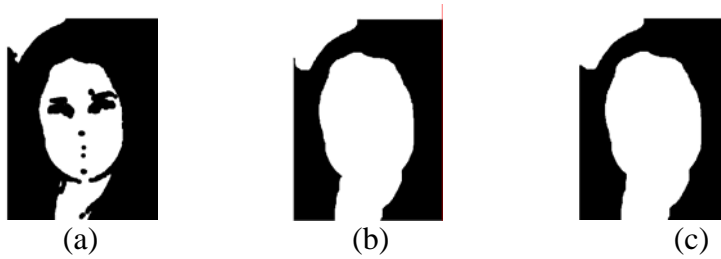


Figure 5: represents the morphological results for YCbCr images such as a) Erosion b) dilation c) closing

The operations of dilation and erosion are illustrated in the figure 4 & 5. In YCbCr image which is in the second row is not perfect so the HSCbCr color space is better than the YCbCr.

3. Mask Creation and Cropping:

Mask Creation is used to create the binary mask which has the value of 0 or 1's. This operation is performed by the function called `roipoly` in matlab software. And the cropping is used to crop the exact position of a face from the image by using `imcrop` operation.

HSCbCr:

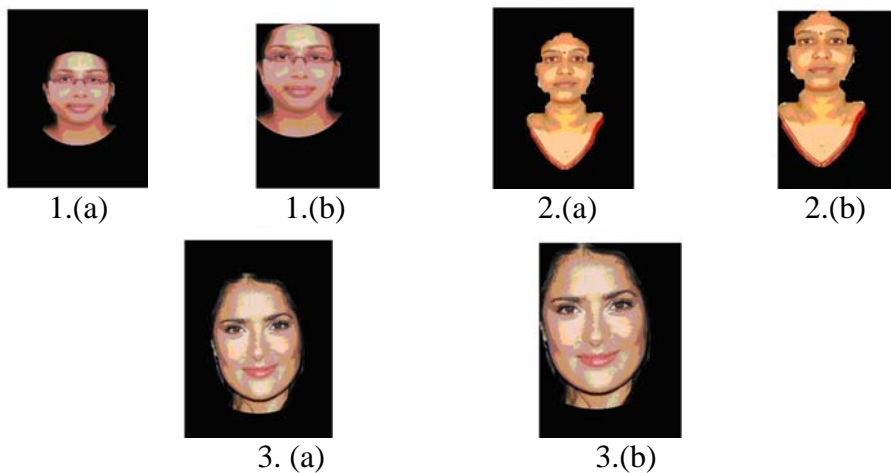


Figure 6: shows the output a) `roipoly` operation and b) crop operation
YCbCr Image:

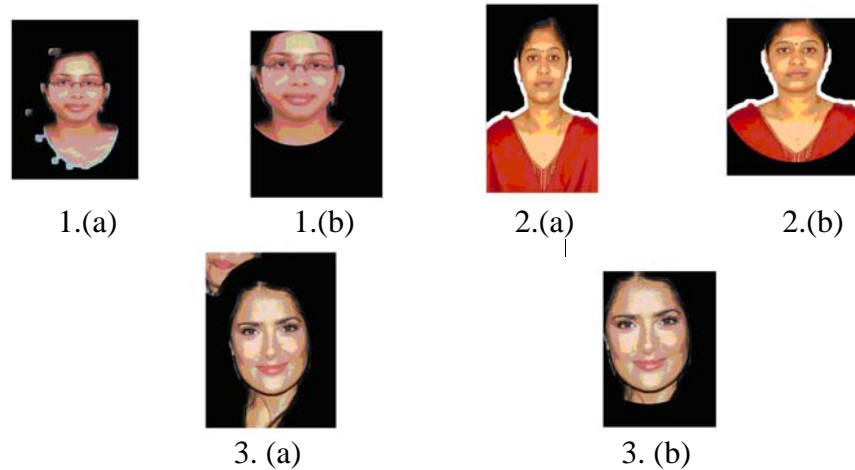


Figure 7: shows the output a) roipoly operation and b) crop operation
Thus the above HSCbCr results are satisfied for the face detection process by using mask creation and crop operation when compared with YCbCr model.

3. Conclusion & Future work

This paper proposed the method of skin color detection to detect the face part of an image by using HSCbCr model. The Hue and Saturation value will be never changed when the lightning effect occurs. Now, YCbCr model is a popular method for skin color detection. So the combination of four components H, S, Cb, and Cr gives the better performance for illumination problem. The overall performance of this model is reasonable compared to the YCbCr model. In future, we are going to use the same model for detection of multiple faces in images and feature extraction for those images.

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References

- [1] Jae Young Choi, konstantinos N.Plataniotis, Yong Man Ro, "A Comparative study of preprocessing mismatch effects in color image based face recognition", journal, August [2010].
- [2] Jae-Ung Yun,Hyung-jin Lee,Anjan umar Paul,Joong-Hwan Baek,"Face detection for video summary using illumination-compensation and morphological processing,journal, April 2010.
- [3] S.Patilkulakarni and H.C.Vijay Lakshmi ,"Segmentation Algorithm for Multiple Face Detection in Color images with Skin Tone Regions using color spaces and Edge Detection Techniques,International journal of computer theory and engineering,vol 2,No 4,August 2010 1793-8201.
- [4] Jose M.Chaves-Gonzalez, Miguel A Vega-Rodriguez,Juan A.Gomez-Pulido,Juan M.Sanchez-perez,"Detecting skin in face recognition systems: A color spaces study",Digital signal processing, 20(2010) 806-823.
- [5] chenguin Liu, jian Yang, Lei Zhang,"Color Space normalization: Enhancing the discriminating power of color spaces for face recognition",Pattern Recognition 43(2010) 1454-1466.
- [6] Iyad Aldasouqi, and Mahmoud Hassan ,"Smart Human Face Detection System",International journal of computers,Issue 2 Vol 5, 2011.
- [7] L.Lorente, J.Y.Reutter, L.Torres ,"The importance of the color information in face recognition, in:Proc. IEEE Int.Conf.Image Process(JCIP,1999).
- [8] C.Liu and P.Shih ,"Improving the Face Recognition grand challenge baseline performance using color configurations across color spaces,in:Proc.IEEE Int.Conf.Image Process.(ICIP)(2006).
- [9] Z.Liu,C.Liu,"A hybrid color and frequency features method for face recognition.IEEE Trans.Image Process 17(10)(2008)1975-1980.
- [10] J.Y.Choi, N.Plataniotis,Y.M.Ro,"Color face recognition for degraded face images,IEEE Trans.Syst.Man.Cybern-Part B 39(5)(2009) 1217-1230.

- [11] C.Liu,"Learning the Uncorrelated,independent, and discriminating color spaces for face recognition",IEEE Trans.Information Forensics and security 3(2) (2008) 213-222.

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