GENERATING SKIN DISTRIBUTION MAP OF FACE IMAGES

Setiawan Hadi, Adang Suwandi A., Iping Supriana S., Farid Wazdi
Informatics Departments, Institute Technology of Bandung Indonesia
Jalan Ganesha 10 Bandung, West Java, Indonesia
E-mail: setiawanhadi@ieee.org

ABSTRACT

Skin pixel visualization in a digital image has been considered as an important clue that can be used in many advanced computer vision applications. This paper describes the steps to present skin distribution by mapping pixel intensities of face-contain images into a two dimensional representation. The face images are originated from three face database groups, those are FERET database, SI synthesized face generator, and Indonesian face database called DWI. Experiment has been performed to visualize the SDM in three chromatic color spaces.

Keywords: *SDM, Skin, Face, Image, Skin Distribution Map.*

1. INTRODUCTION

Skin is one of human properties that has been explored by many scientists and researchers in many areas of applications, ranging from social and natural applications into artificial intelligence and computer vision applications. For the second type of applications, skin image contains useful information that can be used for automatic detection and recognition.

Human skin image contains colors and textures which can be explored using many intelligent technique to obtain information that can be submitted for the next of the applications. Figure 1 shows the image color and texture of human skin color [5].

Figure 1. Human Skin Texture and Color

Due to different geographic locations which is heading to different climate and culture, skin of human is not same. However, there is one characteristic of skin image that makes skin significantly different with other parts of human body. Skin pixels are grouped in one compact region which will be shown in this research using skin distribution map.

2. RELATED WORK

Works have been performed by many researcher related to face detection [4]. Skin colors are often used to determine facial regions because of ease implementation, but its performance is easily degrades by illumination changes. View-based method achieve very high performance for detection faces against complicated backgrounds without using skin colors; however, these method consume much time for searching facial regions exhaustively over the image. Moreover, face alignment is not so precise in general, because such methods ignore high-frequency components of the image to speed up searching.

In computer vision area, skin distribution map is utilized as the preprocessing step of their applications. such as gesture recognition, sign language recognition, adult contents blocking and person tracking and identification [2, 4].

As the popular probabilistic method, skin distribution map depends on the color space that are used for their representation. The color components that will be used for SDM should be reliable and separate the elements of chromaticity from the elements of luminousity. The chrominant color spaces that fulfill this requirement are RGB normalized, HSV and YCbCr [3].

3. GENERATING SDM

Skin distribution map is constructed by assigning a probability distribution value to each point of a discretized color space. The goal of this method is to estimate skin color distribution from the training image data without deriving an explicit model of the skin color.

There are several methods to model skin distribution such as using Normalize Lookup Table (LUT), using Bayes classifier, using Self Organizing Map In this paper only the first method is described.

The Normalized Lookup Table method approaches skin segmentation using a histogram. The color space plane, that is the chrominan plane, is quantized into a number of bins, each corresponding to particular range of color component value pairs. These bins are forming two dimensional histogram which are referred as lookup table (LUT). Each bin stores the number of times this particular color

 ISSN: 1907-5022

occurred in the training skin images. After training, the histogram counts are normalized, converting histogram values to discrete probability distribution using this formula

$$P_{skin}(c) = \frac{skin[c]}{Norm}$$

where *skin*[*c*] gives the value of the histogram bin, corresponding to color vector *c* and *Norm* is the normalized coefficient which is calculated by summing all histogram bin values. The normalized values of the lookup table bins constitute the likelihood that the corresponding colors will correspond to skin.

In practise, the steps to generate SDM can be described as follows:

1. Read an image
2. Determine skin region manually
3. Compose pixel intensity values of that region into its correlated bins based on their intensity values
4. Perform step 3 conditionally until satisfied
5. Performed step 1 for another image

The illustration of this step is presented in the figure 2 below.

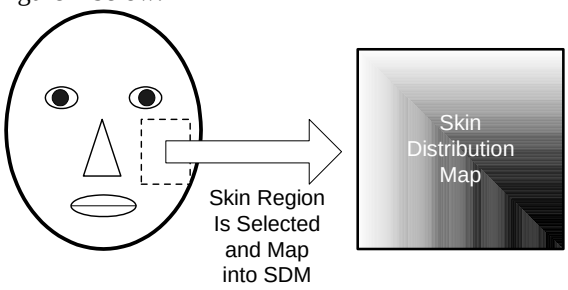


Figure 2. Illustration of SDM Generation

While generating skin distribution map, several statistical characteristics of image pixels are computed. Those statistics are number of skin pixels, average of skin intensities, standard deviation of skin pixels and covarians.

6. EXPERIMENTS

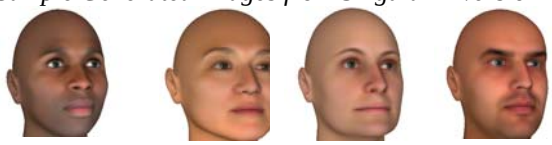
Experiment has been conducted to explore the characteristics of the SDM. Three image face groups have been used in three color spaces. Figure 3 shows several images used in the experiments.

FERET Color Face Database contains 816 face images in color in several positions and type of illuminations. The image resolution is 256x384, man and women, with age range 18-70. The type of image format is PNG. We obtained this database directly in 2 DVDs from National Institute of Standards and Technology U.S. Department of Commerce. This database is a standard database for face detection and recognition.

Image from Singular Inversion's FaceGen Modeller have been generated artificially. There are several option to generate specific ethnics, those are Asian face, African face, European face and India face. Face that are generated are in three dimensional form. There are 201 images created fro this experiments distributed for all ethnics. Image size is 320x320, age range is 20-60 and type of format is PNG.

Sample images from FERET Database

Sample Generated Images from Singular Inversion



Sample images from DWI

Figure 3. Sample Images Used in the Experiment

DWI or Data Wajah Indonesia is our collection of Indonesian faces collected from many sources. For that reason, the images are variative in many cases. There are more than 2000 images have been collected in JPG format.

The result of generating those images in three chrominan color spaces are presented in figure 4 and figure 5.

It is shown that the SDMs are represented in three color spaces, RGB normalized, HSI and YCbCr. Visually, representation in YCbCr color spaces are more compact than any other two representation. Meanwhile the normalized RGB representations show the large range of SDM which can have consequence in the detection stage.

This SDM has been used for face detection which is explained in [3]. A result is shown in the figure 6.

7. CONCLUSION

a. An algorithm for generating Skin Distribution Map has been presented
b. Experiment has been performed using three face database groups in three chromatic color space
c. Statistical characteristics of the visualized skin distribution map has been computed
d. The result shows that the statistical characteristic of natural face image groups (FERET and DWI) is not as compact as Singular Inversion face image group.

 ISSN: 1907-5022

e. Visually, YCbCr space is more compact than any other color space in representing the Skin distribution map

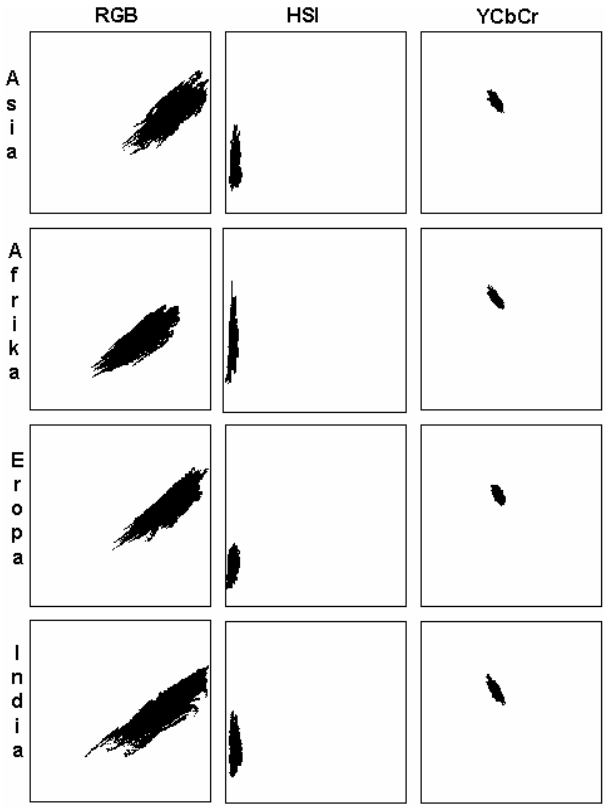


Figure 4. SDM generated from Singular Inversion

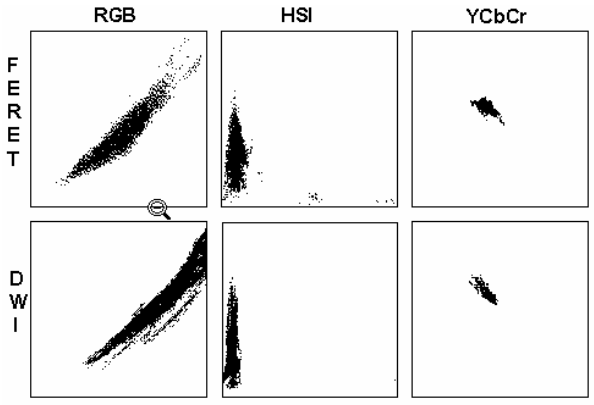


Figure 5. SDM generated from FERET and DWI

8. ACKNOWLEDGEMENT

This work has been performed by support of Indonesian Government thru BPPS scheme, PHK A2 Mathematics Department UNPAD, Program Hibah Pasca ITB.

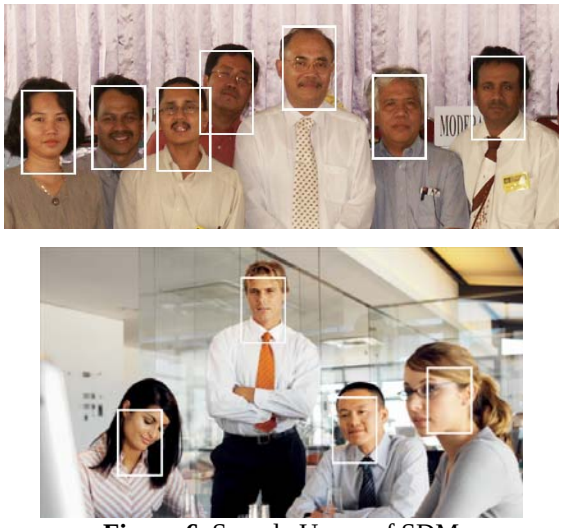


Figure 6. Sample Usage of SDM

REFERENCES

[1] J.D. Brand and Dr. J.S.D. Mason, A skin probability map and its use in face detection, *IEEE Int. Conf. on Image Processing 2001*,vol 1 pp 1034-1037

[2] G. Gomez, M. Sanchez and L.E. Sucar, On selecting an appropriate color space for skin detection, *Proc of 2nd Mexican Conf on AI, LNCS v2313*; pp68-78, 2002

[3] Setiawan Hadi, Pemodelan Distribusi Warna Kulit untuk Klasifikasi Piksel pada Ruang Warna Krominan, akan diterbitkan pada *Jurnal GEMATEK*, September 2006

[4] Atsuhshi Sato, Hitoshi Imaoka, Tetsuaki Suzuki and Toshinori Hosoi, Advances in Face Detection and Recognition Technologies, *NEC Journal of Advance Technology*, Winter 2005

[5] Human Skin Color, *WIKIPEDIA*, last access 15 May 2006.

[6] Vladimir Vezhnevets, Vassili Sazonov and Alla Andreeva, A Survey on Pixel-based Skin Color Detection Techniques, in *Proceedings Graficon 2003*.