Skin Texture Analysis Using Matlab

Bipin Mokal, Aarti Bokade, Uttam Bagal, Swati Checker, Neethu Rajan & G. D. Jindal

Abstract— The objective and quantitative assessment of the skin is important in medical and cosmeceutical research. Assessment of color is an important element for analyzing the surface of the skin, which is usually determined subjectively by a doctor or using color analysis devices. These devices however cannot provide correct color information because color is construed from the mean value of the observation region, and analysis of color distribution is impossible. The purpose of this project is to develop an objective analysis method to permit skin parameters of each pixel. The project is focused on methods of skin analysis based on various algorithms which determine the color of skin. The tests are based on skin pixels on a combination of hue, saturation, intensity and RGB values of individual pixels. The detection of various skin parameters includes the detection of skin tone along with the percent improvement before and after the treatment. MATLAB software was used for programming and processing. Processed output was displayed on the monitor.

Index Terms— Skin analysis, Skin tone, hue, saturation.

1 Introduction

THERE are three major components of the skin. First is the hypodermis, which is subcutaneous (just beneath the skin) fat that functions as insulation and padding for the body. Next is the dermis, which provides structure and support. Last is the epidermis, which functions as a protective shield for the body [1], [4].

The first layer of the epidermis is the stratum basale. This is the deepest layer of the epidermis and sits directly on top of the dermis. It is a single layer of cube-shaped cells. New epidermal skin cells, called keratinocytes, are formed in this layer through cell division to replace those shed continuously from the upper layers of the epidermis. This regenerative process is called skin cell renewal. As we age, the rate of cell renewal decreases. Melanocytes, found in the stratum basale, are responsible for the production of skin pigment, or melanin. Melanocytes transfer the melanin to nearby keratinocytes that will eventually migrate to the surface of the skin. Melanin is photoprotective: it helps protect the skin against ultraviolet radiation (sun exposure) [1], [4].

The Skin Colour Distribution Analyser (SCDA) is an analysis method newly developed at the Research Institute for Skin Image at Korea University. The SCDA system presented in their work performed a novel form of quantitative and objective analysis of skin colour distribution using each pixel colour model parameter found in image wavelength information. Distribution analysis was conducted on normal skin and skin lesions and skin affected by artificially induced irritant contact dermatitis and pigmented nervous. The method selected a grade using a colour model parameter. Twenty healthy Korean males participated in this study. A comparative study of the eight anatomical areas was performed, including the exposure and non-exposure parts and the medial aspect and the lateral aspect of the forearm. A reliability test for the SCDA system was also conducted with a spectrometer (SPEC) using the colour analysis method [2].

Alternative approach looked at skin with respect to RGB values of pixels over the image. These output values taken separately were not similar enough in three pictures to determine anything. However, the ratios of average red values to average green values in three pictures were noticed close. To find out how close, the red green ratio was added to output of skin test [3]. Different types of skin colours are as shown in Figure 1.1.

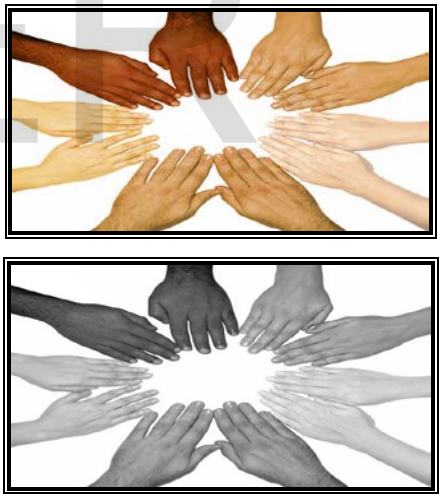

Figure 1.1 Skin tone

Yet another skin tone detection method, proposed by authors is to convert the image to grey scale which gives unique grey value for different skin tones. By deciding the range of grey values the skin tone can be decided. These developments are described in this paper.

2 System Summarization

Images are taken from the subject's skin through MATLAB software. These are stored in the memory with patient id for future reference. Before treatment image which is stored in to the hard disk is retrieved before taking new image so as to adjust patient position and orientation. Distance is maintained

- *Bipin D. Mokal is currently working in Department of Bio-Medical Engineering, MGM's College of Engineering & Technology, Kamothe, Navi-Mumbai – 410209. PH-9881404504. E-mail: bipin.mokal@gmail.com*
- *Uttam Bagal, Aarti Bokade, Swati Checker, Neethu Rajan & G. D. Jindal are currently working in Department of Bio-Medical Engineering, MGM's College of Engineering & Technology, Kamothe, Navi-Mumbai – 410209.*

constant by proper setup of photography room. The region of interest is selected from the image so that only skin of the subject is taken for further processing.

Damaged skin contains various factors such as sun burns, pimples, rashes which are actually discontinuities on the skin. Hence to detect these, edge detection technique is used. After edge detection is done, the closing operation is done to fill the gaps in edge detection. Software uses canny edge detector. The software is developed in MATLAB. The graphical user interface is developed for facilities as follows.

The system block diagram is given in Figure 2.1. Initially there are two options for loading the image. Either image can be taken by camera or image can be loaded from the history of already stored images. If the image has to be taken by camera start the camera using the 'START CAMERA' option to obtain the required image. The image is captured using the 'CAPTURE IMAGE' option. This captured image can be stored in either 'COPT TO BEFORE' or 'COPY TO AFTER' as per the requirement. If image is already loaded 'error' message is displayed.

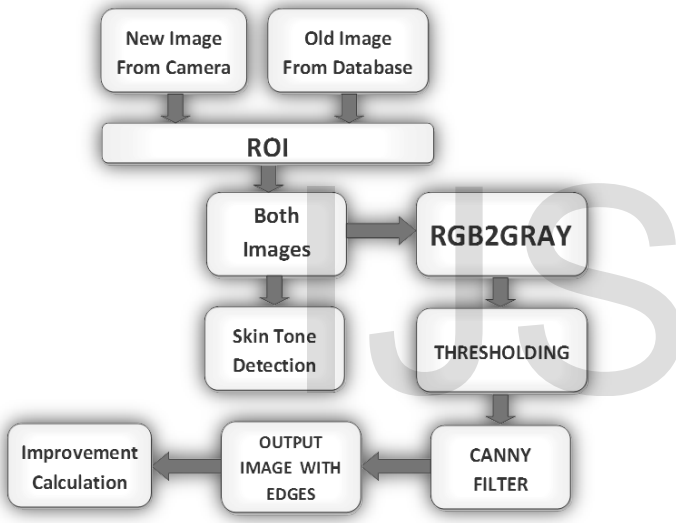

Figure 2.1System Block diagram

Else if the images have to be loaded from already existing images, which is stored at any particular location, it can be done using the 'NEW IMAGE' option. Two different images of the skin of an individual of the same area have to be loaded. One image has to be stored in 'COPY TO BEFORE' and other has to be stored in 'COPY TO AFTER'.

The next step involves adjusting the size of the image. Here the 'region of interest' is selected excluding the unwanted region. This operation is to be performed on the 'before image' and the process automatically repeats to the 'after image as well.

Next the image is converted to grey using 'RGB2GRAY'. After this the edge detection is performed using the canny filter. Here it detects the edges of both the images which show the difference between them if any present.

Finally the skin tone can be determined using 'SKIN TONE' option. This option gives the skin tone of both the images. Photographs are taken at different times and it may cause the problem in different illumination. To overcome this problem the template for skin tone detection scale is made as shown in Figure 2.2. With this template the software is calibrated for different skin tone for the same illumination in which the photographs are to be taken then the gross photograph of subject's skin is taken and skin tone is identified.

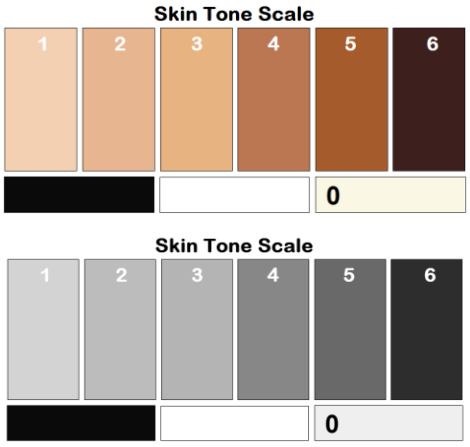

Figure 2.2 Skin tone calibration scale

Then the improvement gives the improvement in the skin from the 'before image' to the after image.

3 RESULTS

Figure 3.1 shows front panel of software developed. Here the images are loaded using 'NEW IMAGE'. The required images are then stored in 'LOAD TO BEFORE' and 'LOAD TO AFFER' respectively. Next the sizes of both images are adjusted and the region of interest is selected using 'ROI' option. Then the colour images are converted to grey using the 'RGB2GRAY' option. The edges are detected using canny filter by the 'DETECT EDGES' option. Finally the skin tone and % improvement is obtained by the 'SKIN TONE' and 'IMPROVEMENT' option respectively. Similar data on few other subjects is shown in Table 3.1

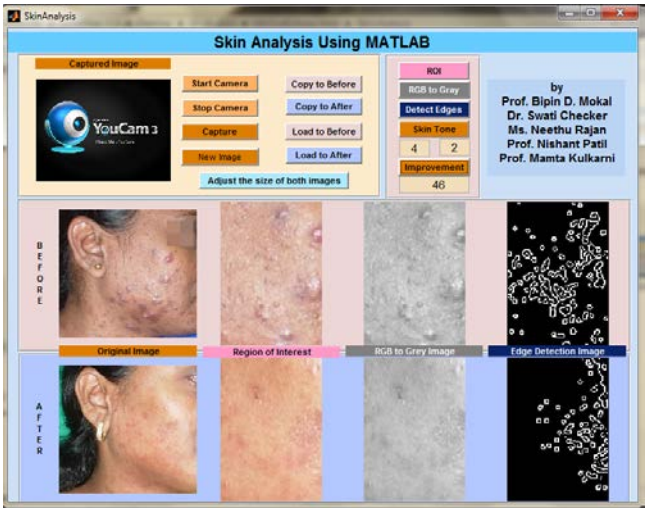

Figure 3.1 Results before and after the treatment

Table 3.1 RESULTS TAKEN OF SUBJECT

Sub (age)	Image before treatment	Image after treatment	skin tone Bf.	skin tone Af.	% Impro.
Sub1 (52)			2	2	87
Sub2 (16)			2	2	63
Sub3 (22)			3	3	75
Sub4 (43)			4	2	54
Sub5 (12)			3	3	75
Sub6 (28)			4	4	72

4 Conclusion

In the context of skin analysis, providing quick and precious information to the dermatologists as well as cosmetologists is not limited to automatic recognition of abnormal skin. In this paper, fast algorithm has been presented and analysed. Simply the parameters related to skin are detected using MATLAB software in which a specific skin area of interest is imaged from RGB to grey and then finally filtered or edge detected wherein finally the results for the same are established.

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References

[1] Wilson, Kathleen Atkins; Waugh, Anne; Chambers, Graeme; Grant, Allison; Ross, Janet (2006). Ross and Wilson anatomy and physiology in health and illness. Edinburgh: Churchill Livingstone. pp. 53–54. ISBN 0-443-10101-9.

[2] Ha S, Lee M, Lee O, Lee G, Kim J, Moon J, Kim M, Oh C. 'A study of a method for distribution analysis of skin color', Skin Res Technol. 2009 May;15(2):200-13. doi: 10.1111/j.1600-0846.2009.00355.x

[3] S. Osher, N. Paragios. 'Geometric Level Set Methods in Imaging Vision and Graphics', Springer Verlag, ISBN 0387954880, 2003.

[4] Guyton, Arthur C. (1991). Textbook of Medical Physiology (8th ed.). Philadelphia: W.B. Saunders. ISBN 0-7216-3994-1.