Accepted Manuscript

Original article

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PII: S1319-562X(17)30030-X
DOI: http://dx.doi.org/10.1016/j.sjbs.2017.01.021
Reference: SJBS 866

To appear in: *Saudi Journal of Biological Sciences*

Received Date: 7 December 2016
Revised Date: 25 December 2016
Accepted Date: 6 January 2017

Please cite this article as: H. Pang, T. Chen, X. Wang, Z. Chang, S. Shao, J. Zhao, Quantitative evaluation methods of skin condition based on texture feature parameters, *Saudi Journal of Biological Sciences* (2017), doi: http://dx.doi.org/10.1016/j.sjbs.2017.01.021

Quantitative evaluation methods of skin condition based on texture feature parameters

Hui Pang, Tianhua Chen *, Xiaoyi Wang, Zhineng Chang, Siqi Shao, Jing Zhao

School of Computer and Information Engineering, Beijing Technology and Business University, Beijing 100048, P.R.China.

Abstract In order to quantitatively evaluate the improvement of the skin condition after using skin care products and beauty, a quantitative evaluation method for skin surface state and texture is presented, which is convenient, fast and non-destructive. Human skin images collected by image sensors. Firstly, the median filter of the 3 × 3 window is used and then accurately detect the location of the hairy pixels on the skin according to the gray mean value and color information. The bilinear interpolation is used to modify the gray value of the hairy pixels in order to eliminate the negative effect of noise and tiny hairs on the texture. After the above pretreatment, the gray level co-occurrence matrix (GLCM) are calculated. On the basis of this, the four characteristic parameters, including the second moment, contrast, entropy and correlation, and their mean value are calculated at 45 degree intervals. The quantitative evaluation model of skin texture based on GLCM is established, which can calculate the comprehensive parameters of skin condition. Experiments show that using this method evaluates the skin condition, both based on biochemical indicators of skin evaluation methods in line, but also fully consistent with the human visual experience. This method overcomes the shortcomings of the biochemical evaluation method of skin damage and long waiting time, also the subjectivity and fuzziness of the visual evaluation, which achieves the non-destructive, rapid and quantitative evaluation of skin condition. It can be used for health assessment or classification of the skin condition, also can quantitatively evaluate the subtle improvement of skin condition after using skin care products or stage beauty.
KEYWORDS Skin beauty; Cosmetic efficacy evaluation; Quantitative evaluation of skin condition; Skin texture feature; Gray level co-occurrence matrix

1. Introduction

People increasingly concern about their own health and beauty in recent years. There is a direct link between the skin state and beauty of health. The surface of the skin condition depends on skin texture characterization. Every object with a physical form has its own unique texture. In other words, different object has different texture, so the texture is a significant character for people to observe and identify objects (Shan et al., 2015; Gao et al., 2011; Song and Li, 2014). Scientific assessment of skin texture is an important approach that could analyse image and evaluate effectiveness of cosmetics and cosmetology. The way of mechanical detection, uses a certain intensity probe to explore, and it is mainly adopted in early evaluation of skin texture and coarseness. As the probe may puncture the surface of the skin, the approach not only has a certain degree of risk but also its precision and sensitivity is not very deal (Dong, 2011; Liu and Liu, 2010). In recent years, silicone film has been widely used to detect the shadow area of skin wrinkle formed by inclined light, and it could get texture index by conversion. This method still has limitations on the sensitivity and accuracy although it could reduce some risks (Xu et al., 2011). The paper achieves objective quantitative assessment of skin texture state by acquiring skin image from the image sensor, calculating the Tamura feature and the GLCM of two-dimensional image and counting skin texture characteristic value in four different orientations.

2. Material and methods

Nowadays, there is no uniform definition of texture. The texture often refers to space distribution of regular and interdependent pixels' gray level in an image area. Texture can be also recognized as a partial basic mode unit which repeats itself in a method of closing to periodicity in a certain image area (Song, 2009). Currently, both in terms of health or skin cosmetic effects, there has been a particular need of scientific analysis and quantitative evaluation of texture state. In traditional medical cosmetology, skin is mainly judged by experimental knowledge of doctors or associated professional staff, which lacks scientific standards.In fact, there are many factors affect skin quality including the skin surface sebum membrane, skin types, living habits, the application of cosmetics and so on. Furthermore, human skin is also affected by age, race, gender, personality and other factors. It shows diversity and has little differences among its shape, colour and texture. Therefore, only using observation or traditional methods is easy to cause a diagnostic error. With the rapid development of computer and digital image processing techniques, image analysis can be used in quantitative analyse of skin texture features according to coarseness and texture measure theory, in order to achieve quantitative appraisal.

2.1. Texture feature of skin image

Currently, there are some main characters of skin texture which are GLCM, LBP (Local Binary Pattern) algorithm, texture spectrum and transform domain method. However, these features have a common shortage of which physical or visual characters are indefinite, having a great possibility to produce inconsistent between checking result and visual feeling. In 1980s, Tamura and others put forward an expression of texture character, according to the psychological research of human perception for texture. There are six components of Tamura texture character corresponding with the six properties in psychological

* Corresponding author.
E-mail address: cth188@sina.com (T. H. Chen).