ABSTRACT

Proper enhancement and segmentation of the overexposed color skin cancer images is a great challenging task in medical image processing field. Computer-aided diagnosis (CAD) facilitates quantitative analysis of digital images with a high throughput processing rate. But, analysis of CAD purely depends on the input image quality. Therefore, in this study, overexposed and washed out skin cancer images are enhanced properly with the help of exact hue-saturation-intensity (eHSI) color model and contrast limited adaptive histogram equalization (CLAHE) method which is applied through this model. eHSI color model is hue preserving and gamut problem free. Any gray level image enhancement method can be easily employed for color image through this eHSI model. The segmentation of these enhanced color images has been done by employing one unsupervised clustering approach with the assistance of seven different gray level thresholding methods. Comparison of the segmentation efficiency of gray level thresholding methods has been done in the cases of overexposed as well as for enhanced images.
INTRODUCTION

Skin Cancer is one of the most common types of cancer that affects human beings. It is a malignant tumour of the skin mainly caused by UV rays. Based on characteristics of skin cancer, they are grouped into two categories, namely Melanoma and Non-Melanoma (Wick, Sober, & Fitzpatrick, 1980). Basal cell carcinoma and squamous cell carcinoma are the most frequent types of Non-Melanoma and they form in the middle layer and upper layer of epidermis respectively (University of Michigan Health System, Kopf, Salopec, Slade, Marghoob, & Bart, 1994). The Non-Melanoma type cancer rarely spreads to other parts of the body. On the other hand, Melanoma is the most vulnerable to all types of Skin Cancer which affect the body rapidly. If it is detected at the first stage, then the survival rate is 100%. The rate of Melanoma skin cancer has increased especially in the USA. Globally the rate of Melanoma Skin Cancer is increasing from 6% to 15% (American Academy of Dermatology, Centers for Disease Control and Prevention, 2017; Elder, 1994; Xu, Jackowxki, Goshtasby, Roseman, Bines, Yu, Dhawan, & Huntley, 1999; Sober, Fitzpatrick, & Mihm, 1979; Xu et al., 1999; Salunke, 2014). To detect skin cancer in the early stage, various image processing based methods have been used. Cancer cell identification and segmentation of the affected area is one of the critical steps of image processing. It becomes more difficult if the accrued image is low contrast. Image enhancement is a pre-processing step in image processing which enhances the quality of an image according to the requirement (Ali, 2004; Hai, Li, & Gu, 2015). The tradition histogram equalization is one of the most widely used image enhancement technique (Gonzalez & Woods, 2002) but it changes the mean brightness of the image middle of the gray level. So, it is not a good result for images like skin cancer. Therefore, in medical image enhancement field some local adaptive variants of the traditional HE like Adaptive HE (AHE), Contrast Limited Adaptive HE (CLAHE) (Hai, Li & Gu, 2015) have been used. Y Hai et. al. have proposed a CLAHE based method to enhance the colour stereoscopic endoscopy images (Hai, Li & Gu, 2015). Sasi et. al. (2013) applied CLAHE on Y component of the YCbCr space to enhance the myocardial Perfusion images. During pre-1980’s input was taken through Gross feature method, but after 2000, it was taken through digital camera or digital microscope. The analysis or detection of cancerous region mainly consist of three stages: 1) Proper Segmentation 2) Feature Extraction and 3) Lesions recognition. Image Segmentation is the first step in the Detection of Skin Cancer Image. It plays a vital role to detect the cancerous region, but the proper segmentation is very difficult due to different parameters like the large variation of the lesion, shape, size and colour along with the different type of textures (Bhuiyan, Azad & Uddin, 2013; Ojala, Matti & Harwood, 1996). Otsu, GVF and colour based image segmentation methods had been used to segment out the cancerous region (Bhuiyan, Azad & Uddin, 2013). Feature extraction was done using ABCD (Nachbar et al., 1994; Ganster, Pinz, Rohrer, Wildling, Binder, & Kittler, 2001) (A=Asymmetry, B=Border, C=Colour, D=Diameter) rule over those segmented images. It had been found that the Otsu Method (Shannon & Weaver, 2001) shows the best result compared to the other methods proposed by Bhuiyan, Azad, and Uddin (2013). A pre-processing method has been used to remove undesired structures like hair from the image and also two segmentation techniques had been proposed which consider the lesion from the beginning using TDS value (Salunke, 2014). If the TDS value is 5.45 of the melanoma skin lesion, then this is the last stage of cancer. The TDS formula is based on the ABCD rule. For melanoma skin cancer the TDS value was said to be greater than 5.45. Xu et.al. proposed a thresholding based method to segment the gray level skin cancer images (Xu et al., 1999). A model of skin cancer lesion diagnosis system has been proposed by Saha et. al. (Saha & Gupta, 2014).