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Normalization Techniques for Psoriasis Skin Lesion Analysis

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Abstract - This paper presents a contribution in the field of image processing for dermatological of skin lesions. Psoriasis skin lesion's images were digitally captured under controlled environment. These images were processed to produce color histograms to obtain color variegation metric. This paper shows that certain normalization technique can be employed to distinguish three types of psoriasis skin diseases infecting the Malaysian population.

1. Introduction

Skin disease can be classified into numerous clinical pathologies. In many cases, early skin lesion diagnosis is difficult and may be confusing, hence may affect treatments to the patients. Various dermatological diagnosis were carried out using color and texture analysis/examination of the skin lesions; in automatic or computerized systems, these attributes were matched to a trained pattern or index values to obtain prognosis [1,2]. The variability of colors and shapes can lead to varied interpretations by different dermatologist. Many researchers used epiluminescene microscopy slides of skin lesions in their analysis [3-7], while some others employed digitized color images directly [1, 8, 9].

Psoriasis is a chronic scaling disease of the Papulosquamos diseases group of skin disorders. It is prevalence worldwide effecting 1% to 2% of the US population and 3% of the Malaysian population [10-12]. It has a variety of clinical presentations, most of which eventuate into erythematous, scaly plaques most often on the scalp, elbows, knees, and lower back, and sometimes with or without nail disease and arthritis [13]. It may range from just a few spots anywhere on the body to large areas of involvement. The exact cause of psoriasis is unknown, but it is recognized that psoriasis is heritable and genetics [14].

2. Skin Lesion Image

The RGB color images were acquired using FinePix 6900 Zoom (Fujifilm) digital camera, with pixel resolution 1280 x 960. It was placed at a distance of one foot directly above the patient's skin. The light intensity was controlled by a standard low flash with default timing. Images and their related clinical evaluations were obtained at Hospital Universiti Kebangsaan Malaysia (HUKM). 612 skin lesion images were captured from 81 patients. Majority (56%) of the sample suffer from psoriasis skin disease, while a smaller number suffered from eczema (17%), dermatitis (11%) and other categories (16%). For this study, only psoriasis disease images were considered, for the above obvious reason.

In clinical diagnostic, dermatologist usually groups the psoriasis skin lesion pattern into four sub-groups, *i.e.* guttate, plaque, pustular and erythroderma. The guttate skin lesions have a discrete and group-like arrangement with poor border definition. The plaque skin lesions have annular arrangement and lesion border are well defined. If the plaque lesions have pustules, the dermatologist named this lesion as pustular. The fourth lesions have generalized arrangement and wide spread reddening areas. From the sample, only one patient suffers from pustular lesion; the rest is almost equally represented. Therefore, the analysis was only applied for the other three psoriasis lesions.

3. Methodology

The normalization techniques are applies to find the most significant method to distinguish the type of psoriasis skin lesions. This normalization technique is proposed to make sure only the lesion color information are taken into consideration. This is because the images consist of safe skin, hair and lesion itself. The normalization

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techniques for skin lesion's images color analysis proposed are:

1. The gray and color components of skin lesion are normalized by the safe skin gray and color components from same patient.

$$(Lesion)_{norm1} = \frac{(Lesion)_{gray,R,G,B}}{(Skin)_{gray,R,G,B}} \quad (3.1)$$

2. The gray and color components of skin lesion are normalized by the frequency distribution of each components of the lesion.

$$(Lesion)_{norm2} = \frac{(gray,R,G,B\ image) - (gray,R,G,B\ image)_{min}}{(gray,R,G,B\ image)_{max} - (gray,R,G,B\ image)_{min}} \quad (3.2)$$

3. The gray and color components of skin lesion are normalized by the frequency distribution and then normalized by the safe skin of each color components from same patient. This normalization technique use Equation 3.2 and followed by Equation 3.1.

After applying normalization technique to the image, the color distribution for the image will be contracted. From the color distribution, histogram for each color components can be produced. Mean value is calculated from each color histogram produced are analyze.

4. Results

Figures 1-4 show the 95% confidence interval graph for gray and RGB color components of normal histogram and three different normalization techniques used in this paper.

Figures 3 and 4 do not indicate any visible distinct features between the lesions. This reveals that normalization by maximum and minimum of histogram are not significant for feature characterization. Figure 1 shows that the normal histograms without any normalization techniques also do not give significant results. Figure 2 shows the mean gray and color components intensity of the normalized mean from safe patient skin. This normalized value shows that each color component lies in different range of frequency distribution according to the psoriasis lesion patterns.

From gray and RGB color components of first normalization technique, gray and blue color component give most significant color component for discriminating three different types of psoriasis skin lesion with the significant of mean difference at 0.05 level. This significant value is valid for all pairs of different psoriasis lesion types. The significant of mean difference value for discriminating the different types of psoriasis lesion is at 0.05 level where the results are very promising.

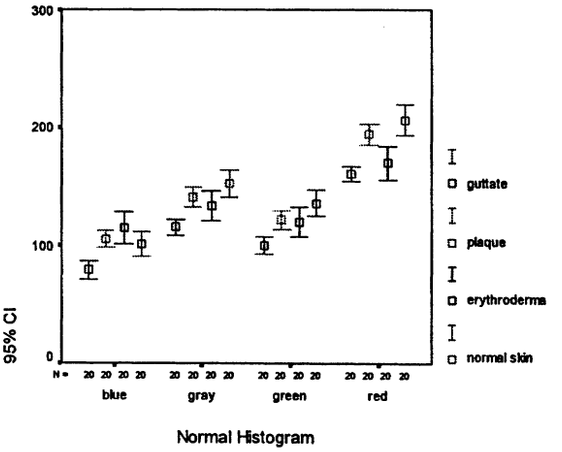

Figure 1: Graphs show results from normal histogram representing the mean intensity values from gray and RGB color components of 20 lesion images of each psoriasis lesion types.

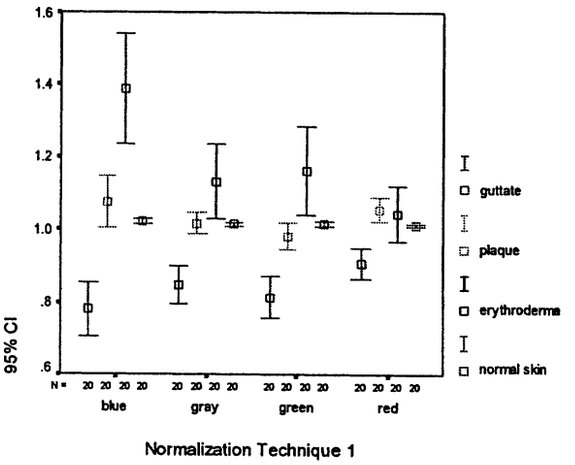

Figure 2: Graphs show results from 1st normalization technique representing the mean intensity values from gray and RGB color components of 20 lesion images of each psoriasis lesion types

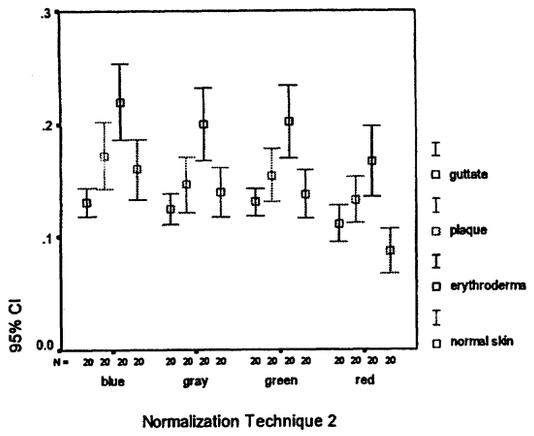

Figure 3: Graphs show results from 2nd normalization technique representing the mean intensity values from gray and RGB color components of 20 lesion images of each psoriasis lesion types.

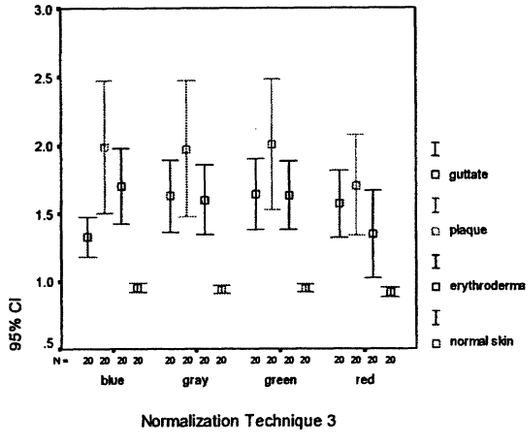

Figure 4: Graphs show results from 3rd normalization technique representing the mean intensity values from gray and RGB color components of 20 lesion images of each psoriasis lesion types.

5. Conclusions

In this paper, we have presented an original color image processing technique applied to skin lesion images. Lesion color information gives important parameter about the clinical presentation of the lesion. The proposed normalization technique can be used to produce the psoriasis lesion color components without influence by other artifacts such as hair, clothes or other color information. The images can be represented as a color histogram from normalized RGB color space can be used to classify the lesion according to clinical description. Therefore, the classified features can be proposed as an input to a pre-diagnostic system to aid dermatologist in their work.

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