Melanoma Cancer Diagnosis Device Using Image Processing Techniques

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Abstract: ***Melanoma is well-known skin cancer that cause fatal. Therefore, detection of melanoma at early stage are essential to enhance the successful of survival rate. For the detection of melanoma, proper analysis is carried out on the skin lesion according to a set of specific clinical characteristics. This skin lesion clinically diagnosed begin with primary clinical screening and dermoscopic analysis, a biopsy and histopathological examination. Lastly, this skin lesion is classified as either "potential melanoma" or "non-melanoma". The process involved are lengthy to the patient and painful. Nevertheless, it can be reducing by automated skin cancer diagnosis base on skin lesions images classification. Automated classification of skin lesions using images is usually challenging, where it is needed to solve multiple task. The input to this tool is the skin lesion images, next apply image processing techniques, and later on this skin lesion images are analyses to conclude occurrence of melanoma. Typically, the analysis to checks for the various Melanoma are using pre-defined thresh-olds in classification stage such as Asymmetry, Border, Colour, Diameter and Evolution (ABCDE) where color, texture, size and shape are being analysis for image segmentation and feature stages. Within the Feature Extraction stage the Feature Values Extracted are being compared and the skin lesion is classified as Melanoma or Normal skin. For most of the skin images, this particular classification method proves to be efficient. This paper intends to provide useful information and methods that been use in skin cancer diagnosis. Hence, it gives good start for researchers to understand automated skin cancer detection at basic level phase***

Index Terms: ***ABCDE and feature extraction, image processing, Melanoma.***

I. INTRODUCTION

Skin cancer happens when normal cells undergo unusual growth and multiply without normal control. Our skin is made up of cells: basal cells, squamous cells and melanocytes. Skin cancer types are named after the skin cell in which the cancer develops: basal cell carcinoma, squamous cell carcinoma and melanoma. Among of the different forms of skin cancer the most dangerous and life threatening is melanoma. Melanoma often start as minuscule, mole-like with a gradual change in size and color variation. Melanoma can grow very quickly and spread to other parts of the body as little as six weeks, if it is untreated. Therefore, it is crucial to diagnose it at very beginning.

Primary stage detection of melanoma needs computer aided detection, in order to assist dermatology, produce the right diagnosis and treatment. Generally, dermatology use biopsy method for examination to diagnosis presence of skin cancer. Skin biopsies at early stage are necessary to identify Melanoma. Biopsy is a procedure to removal or scrapping off the skin. Then this skin samples are undergone various laboratory test. Thus, this process is time consuming and painful. It may cause rise of medical costs for doing skin biopsies unnecessary. Nowadays, medical field depends more on computer-aided diagnosis. This is the great option to distinguish melanoma without increasing the number of biopsies. Computer-aided diagnosis tool will help to increase the diagnosis accuracy as well as the speed, by applying Image Processing techniques. Therefore, automatic diagnosis tool is necessary for dermatologist.

Table 1: Type of skin cancers

Originate	Types of skin cancers
Skin cells - common	Non melanoma - basal cell carcinoma - squamous cell carcinoma
Pigment producing skin cells - dangerous	Melanoma
Tissue in the skin - rare	Cutaneous lymphoma Extra-mammary Paget's disease Merkel cell carcinoma Kaposi sarcoma

This diagnosis tool is able to extract few information consist of color variation, asymmetry, texture features. There are various features or sign of skin cancer such as blue-white veil, multiple brown dots, pseudopods, radial streaming, scar-like depigmentation, globules, multiple colors, multiple blue gray dots, pigmented network [1]-[5]. However, the input to this tool are skin lesion images. This skin lesion image will be analyses. This analysis will be able to classify melanoma or non-melanoma for diagnosing.

The key steps in a processing skin lesion image for diagnosis of melanoma are pre-processing, image segmentation, feature extraction and classifier for diagnosis. In the subsequent section we discuss in-depth each step and methods involved in skin cancer diagnosis.

Revised Manuscript Received on February 11 , 2019.

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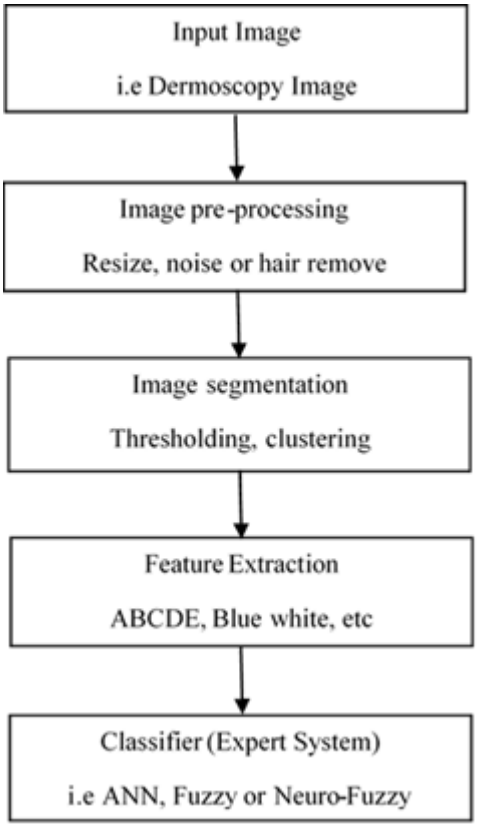

Fig. 1: Skin cancer diagnosis steps

II. RELATED WORK

This section described in detail the process involved in skin cancer diagnosis process. The first section explained about image in pre-processing stage. Then, the next section explained following processes such as image segmentation, features extraction and classifier.

A. Pre-Processing

Initially, the quality of skin images had to be enhance by filtered to remove unwanted hairs, air bubbles, ebony frames and reduce noises. This noises may cause inaccuracies in classification process [7], [8]. Fig. 2 shows image containing hairs and it can be remove using morphological methods, curvilinear structure detection, dull razor software, etc. This is to avoid misclassification.

Fig. 2: Remove unwanted hair

From the enhanced image appropriate feature are extracted by using image processing techniques. The accuracy of the diagnosis is significantly improving accordingly base on right selection of pre-processing techniques [9], [10]. Fig. 3 illustrated pre-processing stages.

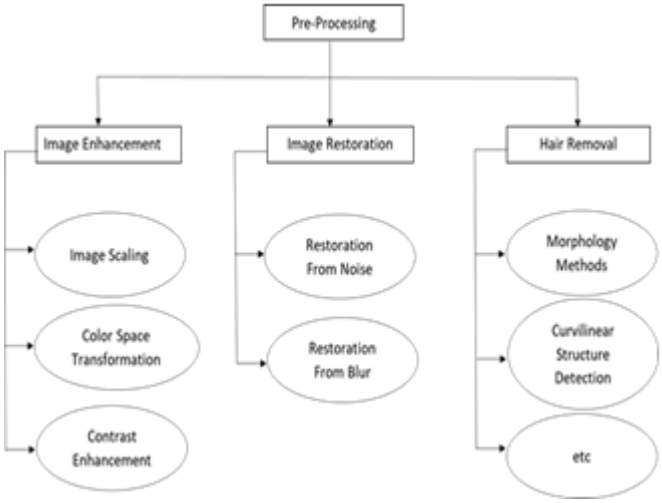

Fig. 3: Structure of framework in pre-processing

B. Image Segmentation

After pre-processing has been done, the segmentation process is carried out to extract lesion area. To perform skin lesion segmentation, the features used in various papers are shape, color, texture and luminance. Segmentation allows to the separating of images into specific regions containing each pixel with associated attributes. The performance of segmentation is measured with different well known measure and the results are appreciable. It has been demonstrated that there are mainly two types of segmentation method [11]-[15] as shown in Table 2.

Table 2: Segmentation techniques in skin cancer detection

Segmentation	Techniques
Low-Level	I. Thresholding II. Region Based Approaches III. Edge Based Approaches
High-Level	I. Fusion based segmentation techniques II. Soft Computing Based Approaches III. Deformable models IV. Other methods

Further, when segmentation subdivides image into its constituent regions or object, it will stop when the object of interest in an application have been isolated. Using edge base approaches, Fig. 4 shows sample result of segmentation that has been done.

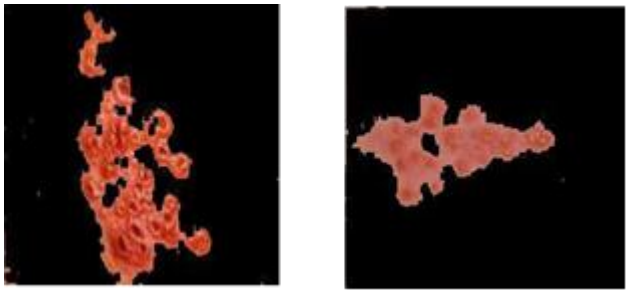

Fig. 4: Sample result of segmentation

C. Features Extraction

Once the skin lesion area has been determining, in consequence of colour, texture and border are related. Therefore, the features are ready to be extracted [16]-[18]. These features are categorized as internal features and external features. Internal features may have obtained some attribute, for instance correlation, energy, homogeneity, mean, skewness, kurtosis, entropy, distribution, standard deviation, etc. [18]. While numerous studies have been carried out regarding extricating features, these studies point out that the most frequently used methods are "Pattern Analysis" [19], [20] or the so-called medical algorithms, such as the "ABCD Rule" [24], [29], the "Menzies Method" [21], [22] and the "7-point- Checklist" [23]-[25]. Fig. 6 shows Various Features Extraction that currently been used. Table 3 shows Various Features Extraction that currently been used.

Table 3: Various features extraction

Extraction Algorithm	Description
Pattern Analysis	Identifies melanocytic lesions and the caliber of malignancy utilizing local and global pattern.
ABCDE Rule	Simply by extricating features, we able to extract information from the lesion images. Friedman et al. (1985), introduced the asymmetry, border, color and diameter rule (ABCD) that was basic in detection of large figures of melanomas. Evolution in lesion over a period was included as fifth criterion.
Menzies Method	Introduced by Menzies et al. (1996), this method probes for negative features.
7-Point Checklist	Assign a score based on 3 major and 4 minor criteria
CASH Algorithm	Color, Architecture, Symmetry and Homogeneity/Heterogeneity algorithm is designed as simplified form of pattern analysis.
Shape Feature	Shape features aid in assessing the asymmetry of the lesion and the irregularity of the border.
Color Feature	Pixel inside the lesion fringe attribute to the color based feature. Variation Of red, green and blue components give the cancer texture.
Texture Feature	A pigmented skin lesion possess visible from of texture.
High Level Feature	Certain dermoscopic structures are utilized by dermatologist for differentiation between the lesion in integration to prevalent features.

D. Classifier

Once the features have been obtained, we have had to choose what classifier to use. There are several well-known classifiers as Instance based classifiers, support vector machine(SVM), Discriminant analysis, Artificial Neutral Network (ANN), Decision Tress, Logistic Regression, Ensemble Classifiers, Bayesian Network and other Classifiers. Classifier is used to classifying malignant melanoma or benign melanoma. We can utilize artificial intelligence methodologies such as artificial neural network, fuzzy based inference system and adaptive fuzzy inference neuro system. A number of researcher does no longer use this type of classifier. As example, irregular streak and blue white veil are the sign of malignancy. They find the irregular streaks by positioning of streaks and path of streaks and confirm those using algorithms [44]. This type of diagnosis approaches is not precise as to compare to machine learning methods because it relies handiest on one feature or criteria.

Previous research has report that numerous skin lesion classification are being used by some of the researchers. In addition, there is pattern classification of the lesion for a perceptually inform model [37]. In the meantime, several studies investigating on methodological approach to determine classification of skin lesion images [16], [38]-[40]. In some other study, an automated approach for skin cancer diagnosis was implemented on a set of dermoscopy images using texture analysis [25]. More recent attention has focus on automated classification system using ANN classifier [31]-[33] it might have been more convincing. Thus, it provides classifier with wavelet and curvelet based capabilities features [26]. In view of all that has been mention so far, we realize most researchers are using multiple classifier in their study [42]. It shows that the facts enhancement in classification can be accomplished.

III. RESULTS & DISCUSSIONS

In pre-processing skin image lesions using color information can be a difficult task as the skin form in images is influenced by different factors for example brightness, background, camera features, and resolution [43]. On the other hand, the lesion localization process are adversely affects the illumination variation in dermoscopic images as shown in Table 4.

Table 4: Various color space

Color Space	Description
Red-Green-Blue	RGB Most digitized lesion images are commonly generated as RGB
Commission Internationale de l'Eclairage	CIE L*a*b, CIE L*u*v and CIE X*Y*Z Produce every color with positive tristimulus values
Luma plus chrominance	Y'CbCr, Y'PbPr, Y'UV and YIQ Color as luminance (Y) computed as a weighted sum of RGB values, and chrominance
Hue-Saturation-Intensity-Value-Luminance	HSI, HSV/B and HSL Imitate the human visual perception of color in terms of hue, saturation and intensity

Since color is one of the features of skin cancer, the mean value of each element of these color spaces could be compute using different color variation of each cancer type and color analysis computed by taking the mean value of RGBs (Red, Green and Blue) components and the mean value of HSIs (Hue, Saturation and Intensity) components. While in image segmentation, the process of dividing an image into distinct partitioned border is a challenge. Basically, we can

decorrelated color space, in which we will explored it, so that we can have a look at the impact of those color spaces in border detection.

IV. CONCLUSION

This paper represents all steps involve in automatic skin cancer detection. In addition, it gives an idea to researchers for selecting the suitable techniques in the automatic skin cancers detection to provide an appropriate result. For future study, researcher can perform additional contrast or correlation in various techniques in detecting skin cancer. Consequently, evaluation of the efficiency can be used for further levels of detection system. We can conclude automated diagnosis of skin cancer its efficient methods, in which it caters all essential steps generally use in computational system for diagnosing skin lesions. Therefore, this paper is beneficial to new researcher working further on detection of skin cancer.

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