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A NOVEL APPROACH IN EARLY DETECTION OF SKIN LESION

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ABSTRACT--Automated diagnostics of skin cancer is one of the most challenging problem in medical image processing. Automatic lesion extraction from skin is very important to help the dermatologists in the diagnosis of cancer part from skin. Dermoscopy is the major imaging modalities used in the diagnosis of skin lesion, such as melanoma and other pigmented lesions. This work presents to pre-process the lesion image to enhance its readability and a technique that automatically segment skin lesions from images. Initially skin images are filtered to remove unwanted noise and then segmentation process is carried out to extract lesion areas. Then the feature extraction techniques are applied on these segmented images. Features are extracted using ABCD rule. Total Dermoscopy Value (TDS) is calculated by using ABCD features. Classification based on ABCD rule is performed with SVM classifier. This classification method proves to be efficient for most of the skin images.

KEYWORDS-- Dermoscopy, Skin Cancer, Melanoma, Feature Extraction, ABCD rule, SVM Classifier**.**

I. INTRODUCTION

Human Cancer is one of the complex disease caused primarily by genetic instability and accumulation of multiple molecular alterations. Cancer can be of two types, benign and malignant. Benign tumors are not cancerous. In most cases, they do not come back. Cells are benign tumors do not spread to other parts of the body [1]. These skin cells make a brown pigment called melanin. Melanin gives the skin its brown colour. Malignant tumors are cancerous and are made up of cells are growing out of control. Cells in these tumors can invade nearby tissues and spread to other parts of the body [1]. Skin lesion is an superficial growth or patch of the skin that does not resemble the area surrounding it. Early detection of skin disease is complex to the inexperienced dermatologist.

Early detection of skin lesion is an efficient way to identify skin cancer at early stage without performing any unnecessary skin biopsies, digital images of skin lesion have been investigated. Melanoma stage accounts for about 77% of skin cancer related deaths [1]. According to World Health Organization, about 132000 melanoma cases, a risky kind of malignant skin lesion, occur each year [2]. Most malignant skin lesion cases can treated

successfully in their early stages [3]. By incorporating digital image processing for skin lesion detection, it is possible to do the identify without any physical contact with skin. For these reasons, developing Computer-Aided Diagnosis System has become a major area of research in the medical field. The aim of the pre-processing stage is to eliminate the unwanted noise and improve the image quality for the purpose of determining the focal areas in the image [4].

Image segmentation is an important step in image analysis, pattern recognition, and computer vision. An segmentation process of skin images can help the diagnosis to define well the region of cancer. For skin lesion detection, ABCD features are most widely used for feature extraction which is based on morphological analysis of dermatoscopic image of skin lesion. After determining an appropriate set of features, the next step is to distinguish the malignant lesion structures from their counterparts. In this step, a region of interest of lesion image is assigned to one of the classes of cancerous, benign. As a part of diagnosis, it is also possible to classify the malignancy level of the tissues [5]. Features are extracted using ABCD rule and skin lesion image are classified using SVM classifier. Support vector machine can be used for classifying the obtained data (Burges, 1998). SVM are a set of related supervised learning methods used for classification step.

II. **DATASET DESCRIPTION**

Creation of an suitable dataset is crucial for any work, as the dataset is a primary thing required for designing and testing the system. Due to the unavailable dataset and permission issues we have created our own dataset by downloading images from internet resources. Images are collected through internet, they exhibit a large intraclass variations with less interclass variations. This sensitivity are necessary in order to ensure accurate pre processing stage such as filtering. In this work, we select two skin lesion: Benign lesion, Melanoma lesion. 70 images were taken into consideration whose results were known previously. All the images considered were high resolution Dermoscopic images. Out of these 70 images, 56 images were classified as Benign, and 24 were classified as Melanoma.

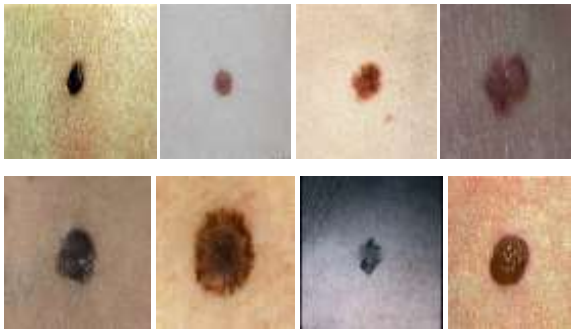

Fig. 1 . (a) Benign

Fig. 1. (b) Melanoma

III. **METHODOLOGY**

The proposed methodology for Skin Lesion Detection using Image Processing is as shown in Fig.2.

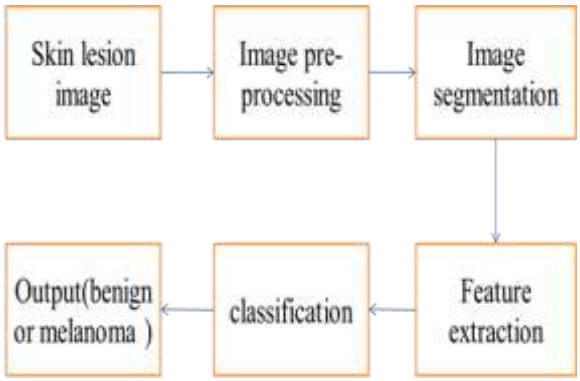

Fig. 2. proposed method for skin lesions classification

The input of the system is the image of the Skin Lesion which is suspected to be a melanoma lesion. This image is then pre-processed for enhance the image quality. The automatic thresholding process and edge detection is used for image segmentation. The segmented image is given to feature extraction block which consists of lesion region analysis for its geometrical features and ABCD features. Geometrical features are proposed since they are the most prominent features of the skin cancer lesion. The extracted features are further given to the feature classification stage which classifies the skin lesion either benign or melanoma by comparing its feature parameters with the predefined thresholds. The input in each step is the output of previous step.

IV. **IMPLEMENTATION**

Step1: Image preprocessing

Captured image may not be in clear. Human skin surface is accumulated by hairs, scars and skin tone difference. Good selection of pre-processing techniques can be improve the accuracy of the system. The objective of the preprocessing stage can be achieved through three process stages of image enhancement, image restoration and hair removal. Median filter is comparison with mean filter is less sensitive to the extreme values. Therefore, it can remove outlier without reducing the sharpness of an image. It is an effective filter for salt and pepper noise. Median filter is employed to perform filtering. Filtering of the images are done by correlation operation. Thick hairs in automated analysis of small skin lesions are considered as a common impediment which are able to mislead the segmentation process. At the end of preprocessing step of skin cancer detection system, the resulting images are distinguishable from those initial images and almost ready to feed the segmentation stage.

Step2: Image Segmentation

The segmentation process is to make things easier or change the representation of an image into something that is more meaningful to analyze. Segmentation means the separation of an image into disjoint regions that are uniform with respect to some property such as luminance, color, and its texture. However, for the development of automated diagnostic system for skin cancer detection, it is very important to develop automatic segmentation algorithms. As segmentation is a early step in the analysis of lesion images. The segmentation is the most important stage to obtain the accurate results at the subsequent stages. It is performed to separate the ROI from the background. The ROI is the cancerous area. It has to separated from the background skin. Otsu's segmentation technique is used in this paper to obtain the ROI. The Otsu's thresholding is an Clustering based image segmentation technique. This technique assumes that the image to be threshold has two classes of pixels and then it calculates the optimum threshold that separates those two classes in such a way that it has a minimum variance. In Otsu's method the threshold that minimizes the intra-class variance is selected by trial and error. Within class variance is defined as weighted sum of variances of the two classes:

$$\sigma_2 w\,(t) = \omega_i\,(t)\,\sigma_{2i}\,(t) + \omega_i\,(t)\,\sigma_{2i}\,(t) \ldots\ldots\ldots (1)$$

where, $i = 1,2,3\ldots$.

Weights ω_i are the probabilities of the two classes separated by a threshold t and $\sigma 2_i$ are variances of these classes. Otsu method shows that minimizing the intra-class variance is the same as maximizing inter-class variance.

$$\sigma^2_b(t) = \sigma^2 - \sigma^2_w(t) \quad \text{..... (2)}$$
$$= \omega 1(t)\, \omega 2(t)\, [\mu_1(t) - \mu_2(t)]$$

The class probability $\omega_1(t)$ is computed from the histogram as t:

$$\omega_1(t) = \Sigma^t_0 p(i) \quad \text{..... (3)}$$

While the class mean $\mu_1(t)$ is:

$$\mu_1(t) = [\Sigma t_0 p(i)\, x(i)] / \omega_1 \quad \text{.....(4)}$$

Where x (i) is the value at the center of the ith histogram bin. Similarly, can compute ω_2 (t) And μ2 on the right-hand side of the histogram for bins greater than t.

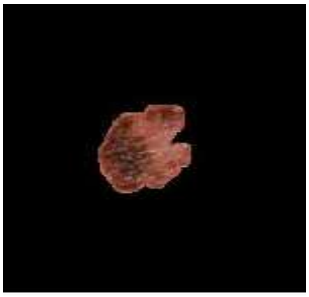

Fig. 3. otsu's segmentation

Step 3: Feature Extraction

Feature extraction is sub-division of improved image into constituent parts of an image for identifying meaningful object. The segmented image is then for extracting feature details such as texture, color and shape. These extracted features are given as an input to the classifier to classify the skin lesion as either malignant or benign. In the conventional procedure, following diagnosis method are mainly used ABCD rule of dermoscopy. In ABCD algorithm following features are extracted.

Asymmetry

One-half of the lesions do not match the other half of the lesions. Asymmetry is calculated by dividing the image over its closest line of symmetry. Finding the area of the non overlapping sections and then the difference between these areas. The obtained results are divided by total area. The mathematical expression used to calculate percentage of asymmetry is

$$\text{Asymmetry} = (\Delta P / P) * 100$$

Where, ΔP = Pixel difference

P =Total Pixel count of lesion

Fig. 4. Asymmetry

Border Irregularity

In melanoma cases, the borders of the lesion are irregular, ragged, blurred. So, the edge or the border are first recognized and then fetched from image excluding the inner, outer parts of the mole. Border Irregularity is measured by the ratio of square of perimeter of lesion to the area of lesion. It is computed by,

$$B = P / 4\pi T$$

Where 'P' is the perimeter of lesion boundary and 'T' is the area of the lesion. Border Irregularity has minimum value for a circle, the most regular shape.

Fig. 5. Border

Color

The lesion color varies over with different shades of brown or black, red, white or blue. A score of one is assigned on presence of each color in the image. Color texture might be used for determining nature of melanocytic skin lesion. The pigmentation are not uniform. The presence of up to six colors must be detected - white, red, light brown, dark brown, slate blue, and black. Color Variegation is quantified by the normalized standard deviation of red, green and blue component of lesion. They are expressed as,

$Cr = \sigma r/Mr$

$Cg = \sigma g/Mg$

$Cb = \sigma b/Mb$

Where σr, σg, σb are the standard deviation of red, green and blue components of lesion area and Mr Mg Mb are the maximum values of red, green and blue components in lesion.

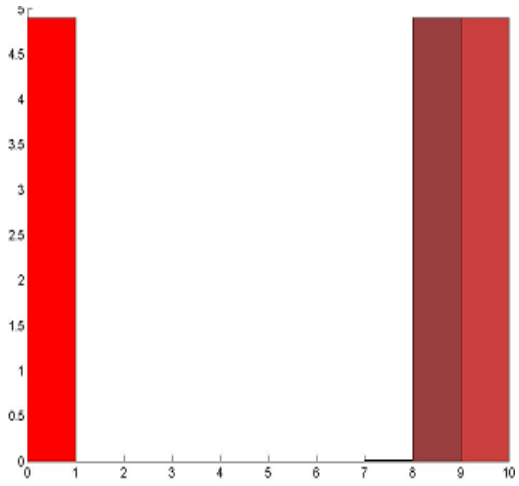

Fig. 6. color

Diameter

The diameter is larger than 6 mm or growing is classified to be melanoma. A score of 5 is assigned for diameter greater than 6mm. Diameter of lesion is calculated by,

$D=2a$

Where a is semi major axis of the best fit ellipse.

Total Dermoscopy Score:

After the value of four components ABCD is found, then TDS value is calculated. For final diagnosis result, Classification is done using TDS.

$TDS = A*1.3 + B*0.1 + C*0.5 + D*0.5$

TDS value is greater than 5 then consider as melanoma. TDS value is less than 5 consider as benign.

Step 4: Classification

The feature values are extracted in the feature extraction stage are compared and the skin lesion is classified as benign or melanoma. Then the classification is performed with SVM classifier. This classification method proves to be efficient for most of the skin images. SVM are a set of related supervised learning methods used for classification and regression. They are belong to a family of generalized linear classifiers. Let us denote a feature vector (termed as pattern) by $x=(x_1, x_2, \cdots, x_n)$ and its class label by y such that $y = \{+1, -1\}$.

SVM for Linearly Separable Data

A linear SVM is used to classify data sets which they are linearly separable. SVM linear classifier tries to maximize the margin between the separating hyper planes. The patterns lying on the maximal margins are called support vector. Such as, a hyper plane with maximum margin is called maximum margin hyper plane.

SVM for Linearly Non- Separable Data

For a non-linearly separable data, it maps the data in the input space into a high dimension space with kernel function $\Phi(x)$, to find the separating hyperplane.

V. RESULT

In First step, the Skin Lesion Mask is formed and then it is applied on the input image

to obtain the segmented image. Input image of the skin lesion is efficiently segmented for both mole as well as Melanoma Cancer Image using proposed segmentation method. 30 images were taken into consideration whose results were known previously. All the images considered were high resolution Dermoscopic images. Out of these 70 images, 24 images were classified as benign, and 56 were classified as melanoma. 25% of error was observed due to miscalculations. Hence this work proposes a computer aided method for skin cancer detection with an accuracy of 75%.

(i)Input image

Fig. 7. input image

(ii) Segmented image

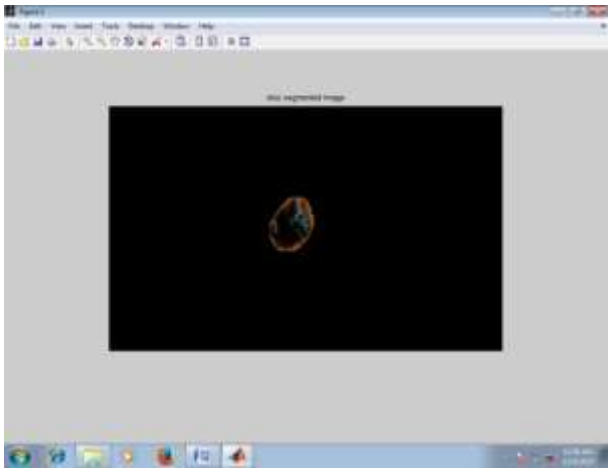

Fig. 8. Segmented image

(iii)Classification Result as benign

Fig. 9. Classification Result

VI. CONCLUSION

This work is explores the pre-processing and segmentation techniques for skin lesion images. Skin lesion areas are segmented using otsu's segmentation method. Later, asymmetry, border, color, diameter features are extracted to represent segmented lesion areas. Then the classification is performed with SVM classifier. Experiments are conducted on own dataset of 50 lesion samples. The results obtained have demonstrated the ability to classify benign and melanoma lesions. The computer aided detection has proven to be quick, spontaneous and cost effective. This work more user friendly and robust for images acquired in any conditions. In future work, a new segmentation and classification technique will be proposed to classify the skin lesion images and to improve the performance of the system and find the cancerous skin images.

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