ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Detection of Malignancy of Skin Lesions Based on Local Texture And Fractal Analysis.

Bethanney Janney J[1]* , G Rohini[2], and J Pauline[3].

[1]Research Scholar, Faculty of Electronics Engineering, Sathyabama University, Chennai, India.
[2]Department of Electronics and communication Engineering, St. Joseph's Institute of Technology, Chennai, India.
[3]Department of Biomedical Engineering, Sathyabama University, Chennai, India.

ABSTRACT

Skin cancer, the deadliest form of cancer, must be diagnosed early for effective treatment. Skin cancer can be defined as skin growths with differing causes and various degrees of malignancy. This paper describes novel image processing approaches for detecting how malignant a skin lesion is, based on its texture feature and fractal feature analysis. Fractal features refers to the geometry of the skin lesion and its analysis quantifies complex shapes of the tumor. Whereas texture features refers to the contrast of the cancer image, homogeneity, energy, entropy, etc. Images are taken using a dermatoscope and digital camera. Fractal dimensions are calculated on these images as it has been already experimentally proven that most of the information about the malignancy of the tumor is contained in the contours of the tumor shape. Fractal analysis helps in differentiating malignant tumor from a benign tumor. The texture and fractal feature analysis is done with the help of Grey Level Co-occurrence Matrices (GLCM) technique. The decision whether the image given is cancer image or non cancer image, is done at the decision block with the help of Support Vector Machine (SVM).

Keywords: skin cancer, segmentation, feature analysis, GLCM technique, Support Vector Machine.

***Corresponding author**

INTRODUCTION

Skin cancer is the most frequent types of cancer and one of the most malignant tumors. In USA it is found that each year, more new cases of skin cancer are diagnosed than all other cancers. According to the skin cancer foundation-statistics in Americans lifetime, one in five of them will develop skin cancer. There are three types of skin cancer: Basal cell cancer, squamous cell cancer and melanoma. Basal cell cancer and squamous cell cancer are called non-melanoma skin cancer and they are common but less dangerous. Melanoma is danger and it is more likely to spread. Melanoma can be cured if it is detected in an early stage, can achieve cure ratios of over 95%. Currently the diagnosis of skin cancer is done mainly by a human, who is called dermatologist. During diagnosis, a dermatologist exam the skin carefully by his eyes or using a device called dermascope. Although the procedure used by them is standard, a dermatologist has subjective bias and the correct diagnosis depends on a dermatologist's experience. Besides, the procedure examined by a dermatologist takes long time. In order to improve the diagnosis rate, skin cancer detection techniques have been investigated to aid the dermatologists for early detection. Therefore this study investigates and reviews important aspects of automated analysis of skin lesions using image processing technique [1,2].

METHODOLOGY

The proposed system uses a novel approach to classify skin lesions. It does so by capturing an image of the affected skin area using dermascope, the skin cancer image is given to the interface [3].The proposed block diagram is shown in the Fig .1.

Auto level stretching

The color image is converted into gray scale image, the image undergoes auto level stretching, stretching the grey scale from minimum to maximum from (0-255).Next step followed by taking histogram of the image [4]. Histogram is a graph showing the number of pixels in an image at each different intensity value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance.

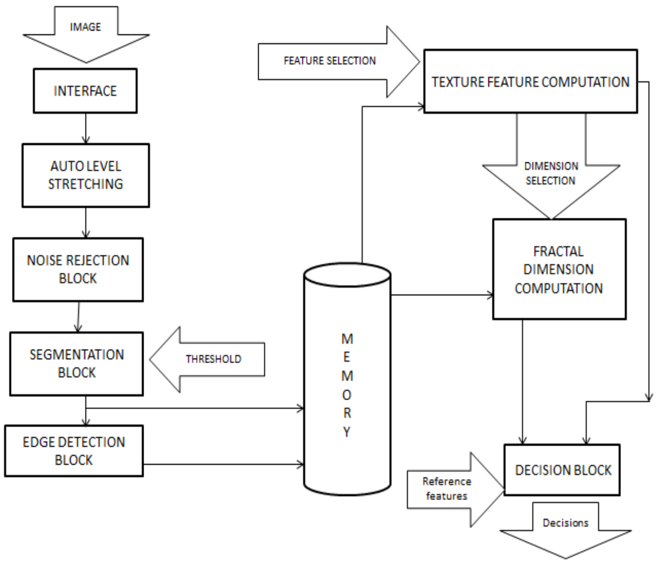

Figure 1: System Architecture

Noise Rejection Block

Skin cancer images acquired generally contain noise and hairs, thus noise reduction technique is used in the system so that the segmentation results will be more accurate. Many techniques were developed for noise reduction; here in this study we use three different filtering techniques such as Median filter, Laplacian filter and Gaussian filter [5].

Segmentation

The purpose of image segmentation is to find and outline distinct objects of importance in an image. For example, for images of skin lesions, the border of the skin lesion should be identified. Segmentation in general is a very well-researched area and many different algorithms have been proposed. In this study first, thresholding is done to separate out the regions of the image corresponding to objects in which we are interested, from the regions of the image that corresponds to the background [7].Second, Watershed segmentation algorithms have been designed specifically to be applied to images of skin cancer. It grows regions of pixels around the local minima of an image, and it ensures that the boundaries of adjacent regions lie along the crest lines of the gradient image [6].

Edge detection

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene.Edge is detected from the filtered image using sobel filter [8].

Texture feature and fractal feature analysis

Texture analysis is used to classify, segment and synthesize an image.It is a useful computational method for differentiating pathologically different regions on medical images. Fractal analysis is the analysis of the geometrical figures, density, contours, etc in an image. The texture and fractal feature analysis is done with the help of Grey Level Co-occurrence Matrices (GLCM) [9 & 10]. The most powerful statistical method for textured image analysis is based on features extracted from the GLCM. GLCM is a second order statistical measure of image variation and it gives the joint probability of occurrence of grey levels of two pixels, separated spatially by a fixed vector distance *d* = (D*x,* Dy). The range of grey level values within a given image determines the dimensions of a co-occurrence matrix. From a co-occurrence matrix one can draw out some important statistical features for texture classification. From the statistical features few among the many are selected due to their good discriminating power. These include Energy, Entropy, Contrast, Correlation, and Homogeneity [11]. Formulae for calculating different GLCM features are given in the Table I.

Decision Block

Decision is made with the help of Support Vector Machine (SVM).Support vector machines are supervised learning models that analyze data and recognize patterns, used for classification analysis [12 &13].SVM takes a set of input data and predicts, for each given input, which of two possible classes forms the output, making it a non-probabilistic binary linear classifier. The SVM calculates the GLCM features at 4 different angles (0, 45, 90 and 135).These values are then averaged to get either a negative value or a positive value. The positive value will lie above the hyper plane and the negative below. This helps in the classification process.

Table I: Formula for Calculating Different GLCM Features

Texture Feature	Formula
Contrast	$\sum_i \sum_j (i-j)^2 P_d(i,j)$
Correlation	$\frac{\sum_i \sum_j (i-\mu_x)(j-\mu_y) P_d(i,j)}{\sigma_x \sigma_y}$
Energy	$\sum_i \sum_j P_d^2(i,j)$
Entropy	$-\sum_i \sum_j P_d(i,j) \log P_d(i,j)$
Homogeneity	$\sum_i \sum_j \frac{P_d(i,j)}{1+\lvert i-j \rvert}$

EXPERIMENT AND RESULTS

The following experimental results have been obtained by performing the digital image processing techniques. The final result obtained after all these procedures on the image is that whether the given image is cancer image or not. It is found that the result obtained due to the application of above mentioned techniques is much more accurate than the other methods. The results obtained are as given below; The cancer image is taken using the dermatoscope and a digital camera. A clear picture is obtained due to the illumination and magnification provided by the dermatoscope.

(a) (b) (c)

Figure 2: (a) Skin cancer image (b) Gray image of skin cancer (c) Histogram of the image

The above given cancer image is converted into grey scale image, for the effective utilization of existing image processing algorithm. This transformation is also for efficient computation because grayscale image manipulation requires less computational power than color image requires. An input cancer image, its gray image and histogram of cancer image is depicted in Fig. 2. Filtering is done to remove noises. A comparison is done on various filters. Fig. 3.Showed the results of filtered image. The image has been segmented by using thresholding and watershed algorithm method in which boundaries are extracted and the result is displayed in Fig. 4. During the feature extraction process the stored pixel value of the infected part of the human skin are extracted and the features like Energy, Entropy, Contrast, Correlation, and Homogeneity etc., are calculated for each occurring pixels these values are stored in the system data base which are useful in classification phases. This analysis is performed using Grey Level Co-occurrence Matrices (GLCM) technique and the comparison table for both cancer and non-cancer image is obtained in Table II. Finally the decision block gives the output that the given image is that of cancer or it is not. The decision is made using Support Vector Method. Mat lab tool have been used for processing all these techniques the method followed by Krasula et al [14].

(a) (b) (c)

Figure 3: Filtering results of the images (a) Gaussian filter (b) Laplacian filter (c) Median filter.

(a) (b) (c)

Figure 4: Segmentation results of the images (a) Gradient magnitude of the image (b) Segmented image (c) Image with its edge detected.

Table II- GLCM Values of Sobel

FEATURES	CANCER IMAGE 1	CANCER IMAGE 2	NON CANCER IMAGE 1	NON CANCER IMAGE 2
Autocorrelation	2.42E+00	1.85E+00	1.77E+00	1.49E+00
Contrast	5.45E-02	4.99E-02	3.52E-02	1.96E-02
Correlation	8.92E-01	8.82E-01	9.09E-01	9.29E-01
Energy	4.49E-01	5.39E-01	5.77E-01	7.04E-01
Entropy	8.97E-01	7.90E-01	7.25E-01	5.40E-01
Homogeneity	9.73E-01	9.75E-01	9.82E-01	9.90E-01

CONCLUSION

In this study we use cancer images taken by a dermatoscope and a camera in order to do further analysis and setting coding for detecting whether the image given is of cancerous nature or not. The result from a dermatoscope is obvious, committed patients, provides a better diagnostic accuracy as well as lower excision rates. Color images are obtained from a dermatoscope. These color images are converted into grey scale images. Histogram is calculated where tonal distribution of the image is obtained. This helps in the calculation of the intensity values of the image given. The image obtained contains unwanted information which is considered noise which will interfere in getting proper results. The noise is effectively removed by filters. Various filters are used here from which the best is selected according to its effectiveness in reducing the noise. This can be done by calculating SNR (Signal to Noise Ratio). This filtered image is then taken in order to perform segmentation. The segmentation procedure used is watershed method. Then the edge is detected using Sobel edge detection method. This gives an outlined image which is sent for texture and fractal feature analysis. The analysis is done with the help of GLCM technique; this analysis result will give most of the information about the image. This helps in detecting whether a given lesion is cancerous or not. Further the decision block gives the output that the given image is that of cancer or it is not. The decision is made using SVM (Support Vector Method). This method is considered to give good result within less time. It is taken to be as an effective method as it's a result of many analysis performed so as to get the appropriate technique without compromising the information on an image.

ACKNOWLEDGEMENT

We would like to thank our Sathyabama University management for their guidance and support and facilities extended to us.

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