Volume 7, Issue 4, April 2017 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Melanoma Detection from Dermoscopic Images Using Gaussian Mixtures and Artificial Neural Network

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Abstract: ***The malignant melanoma is the most deadly form of skin cancer. Early diagnosis is an important that increases chances of successful cureas there is rapid course of the disease. It is costly for dermatologist to screen every patient for melanoma. There is a need of system to assess the lesion area based on dermatological photographs. Image processing andComputer analysis are the efficient tools which helps medical diagnosis. So to get the effective results and information of various stages of the infected portion, there is need of features of that particular area .So the feature extraction phase is hugely dependent on the region detected which has the disease. So suitablesegmentation algorithm is required which can affectivity detect the skin melanoma pixels in the information image. In this work, we proposed an algorithm which can detect the pixels which have melanoma region and ordinary skin. In proposedwork Gaussian mixtures posterior algorithm is presented. Which chooses some candidates from different regions of the images which have different intensity values and further Gaussian models have been built from the chosen places. In the end Artificalneural network has been implemented to get final segmentation results. Experimental results show that the algorithm gives 97% accuracy results on the tested database images.***

Keywords-Melanoma, Segmentation, GMM, ANN.

I. INTRODUCTION

Computer-aided diagnosis (CAD) systems have been quickly being developed over the previous decade for skin cancer classification. In fact, an impressive role of CAD systems is to give a "second opinion" to the dermatologists in their decision making for successful diagnosis of patients. In dermatology, the significant types of lesions for skin cancer are divided into malignant melanoma and non-melanoma. Melanoma is a most frequent type of the melanocytes it is a type of cell that is found in the skin's epidermis and its incidence has been increasing over last few decade. Melanoma mostly occurs on the trunk or lower extremities and is the most malignant form of skin cancer [1] .A cancerous lesion in the pigment bearing basal layer of theskin is the most treatable and with the cure rate of 100% in the early stage. Theproblem consists in identifying the small percentage of skin lesion that develops melanoma [2]. The advanced cutaneous melanoma is still downhearted, but when examined at early stages it can be cured without complications. The separation of early melanoma from other non-malignant pigmented skin lesions is important even for experienced dermatologists. In several cases primary care physicians miscalculate melanoma in its early stage [3].The main idea of image segmentation is to group pixels in homogeneous regions and the approach used is 'common feature'. The features can be represented by the space of color, texture and gray level [4]. In this paper, the problems of skin image segmentation using a hybrid path for the separation of pigmented skin lesions from normal skin and the feature extraction from the separated regions are analyzed.

II. COMPLETE LIFE CYCLE OF AN AUTOMATED SYSTEM FOR THE DETECTION OF MELANOMA

Using the dermoscopic technique the complete life cycle of an automated system for the detection of melanoma, consists on the following stages:

1. Image acquisition: The acquisition of the dermoscopic image is done.
2. Image preprocessing: The preprocessing of the image is done. For example hair, bubbles, flashes, shadows, ink marks in the skin, electronic marks (generally computerized identifiers or copyright data), black frames and devices and rulers to measure.
3. Skin lesion segmentation: The skin lesion segmentation is done. It comprisedof an automated way, there exist semi automated systems in which the expert is permitted to intervenein this stage, presenting information for the segmentation improvement.
4. Detection and characterization of indicators: The automated detection and characterization of the picked indicators to endeavor the diagnosis.
5. Diagnosis: On the basis of the medical algorithm, the quantitative count of the malignancy level of threat is made.

III. EXISTED WORK

Amit Mehta et al. [5] proposed the task of extracting, classifying and segmentation of dermoscopy image using supervised learning approach that is multi-layer feed forward neural network. The features are extracted from dermoscopy image using genetic optimized Fuzzy C Mean clustering approach.Nilkamal S. Ramteke et al. [6] presents an approach for skin cancer detection and analysis from given picture of infected area. The proposed scheme is Wavelet Transformation for image improvement, denoisingand Histogram analysis and finally fuzzy interference system for final decision of skin type based. Combination of ABCD rule and wavelet coefficient shown classification accuracy by 60%.Hitoshi Iyatomi et al. [7] proposed an internet based melanoma screeing system which involves area extraction algorithm which calculates characterization of the tumor. The sensitivity achieves is 85.9% and Specificity is 86%.Nagaraj et al. [8] have proposed a technique called automatic segmentation of skin lesion in traditional macroscopic images. This method is based on stochastic region merging (SRM). In the proposed method region adjacency graph (RAG) is adopted for the segmenting of the skin lesion from macroscopic images based on the discrete wavelet transformation (DWT).ArushiBharadwajet al. [9] proposed segmentation method Implemented in mat lab, the features of the same is implemented on STOLZ algorithm and verified according to TDS parameter in order to analysis the stage of melanoma .Jeffrey et al. [10],In this a novel texture based skin lesion segmentation algorithm is proposed. A set of representative texture distributions are carried outfrom askin lesion image and texture distinctiveness metric is calculated for each distribution. The proposed segmentation is tested by comparing lesion segmentation result and melanoma classification.

IV. STEPS OF PROPOSED ALGORITHM

1) Read the demoscopy image and convert into Lab color Space.
2) For each pixel store the neighborhood pixel in an array.
3) Apply Pre-clustering step and get texture candidate from different clusters.
4) The candidates which are choose Gaussian mixture model is performed.
5) Get the posterior of every pixel using Gaussian mixture and further put that pixel to the cluster which matches.
6) From the segmentation results get the rough segmentation as normal skin and lesion portion.
7) Use ANN for final segmentation for Training and Testing.

V. TECHNIQUES USED

A. Image Acquisition

Images of melanoma are captured using the method dermoscopy or epiluminance microscopy. It uses equipment called dermatoscope to detect the skin lesion closely. In this work, the dermoscopy images of infected melanomaare gathered from the internet.

B. L∗a∗bcolor space

The L∗a∗bcolor space is considered which enables to evaluate the visual differences. The L*a*b* space consists of a luminosity layer 'L*', chromaticity-layer 'a*' showing where color falls along the red-green axis, and chromaticity-layer 'b*' presentation where the color falls along the blue-yellow axis. Greater part of the color information is in the 'a*' and 'b*' layers. We can measure the difference between two colors using the Euclidean distance metric.

C.Clustering

1) Fuzzy C-Mean

FCM is a technique of clustering which enables one piece of data to belong to two or more clustershaving different degrees of membership. Whereas in hard clustering an elementbelongs only to single cluster [11].In this work, FCM has been exploited as pre-clustering step to get texture candidates which are further used by Gaussian mixtures.

2) Gaussian Mixtures

A Gaussian Mixture is a parametric likelihood density functionwhich is weighted sum of Gaussian component densities. Their parameters are evaluated from preparing information utilizingMaximum A Posteriori (MAP) the iterative Expectation-Maximization (EM) calculation or estimation from a well-trained prior model [12].In this Gaussian mixtures are worked for some chosen pixels have different neighborhood intensity values from one another. Further segmentation has been done to get the rough idea about skin cancer pixels and normal skin pixels which are improved by ANN.

D. Neural networks for classification

Artificial neural networks (ANN) consider classification as one of the dynamic research and application areas. ANN as a classifier is consideredin which the different combinations of functions, its effect and the correctness of these functions are calculate for various kinds of datasets. The clustering andclassificationof these data sets are important. The data set is divided into training set and testing set and it has no usage in the training procedure. With the help of these datasets,the outputs are produced and it is used for testing. This is made through the estimation of the accuracy attained through testing against these data sets. Further the network is simulated with the same data. To train the neural network, back propagation algorithm is used.There must be input layer, at least hidden layer and output layer. [13]

VI. EXPERIMENTAL RESULTS

Experimental results have been explained in this portion in which skin melanoma cancer images are used. Output results for different images are provided in the last and resulted output at different points has been shown for

single image. Sensitivity and specificity of each image has been found using ground truth lesion pixels marked manually by the observer.

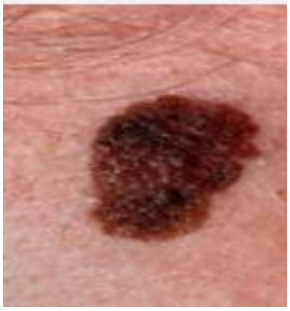

Fig 1: Image used for experimental results

Fig 2: Ground truth of above image from observer's point of view.

Below are results for few images that have been tested by this algorithm

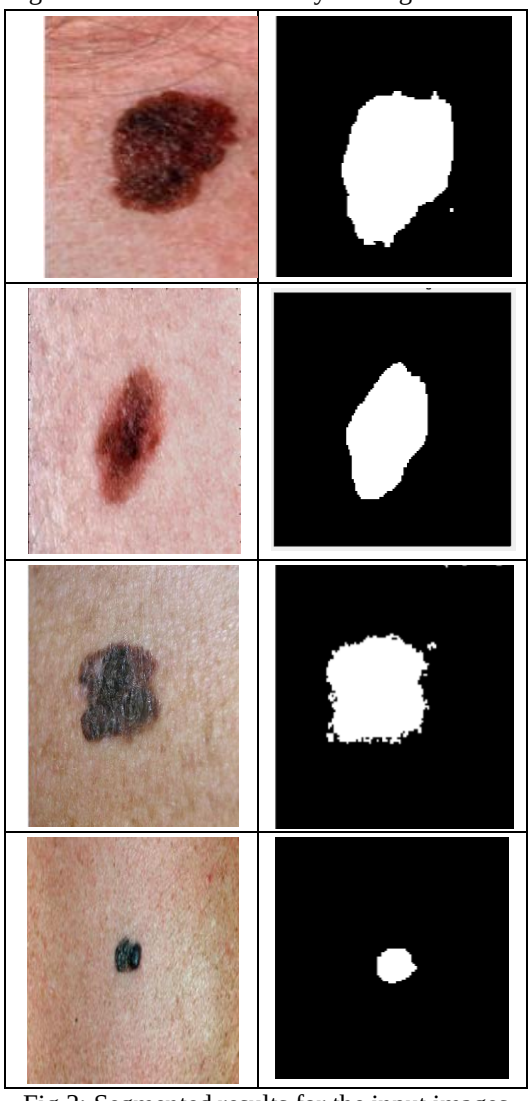

Fig 3: Segmented results for the input images

1. Sensitivity: Sensitivity represents the proportion of true positive subjects with the disease in a total group of subjects with the disease (TP/TP+FN).
2. Specificity: Specificity is complementary to sensitivity. It is defined as the extend of subjects without the disease with negative test result to the overall number of subjects without disease (TN/TN+FP).Where TP is true positive, FN is false negative, TN is true negative and FP is false positive of the pixels found by ANN as for ground truth.
3. Accuracy: This is the mean of sensitivity and specificity parameters Following is the bar graph which is measured with ground truth images and segmented results by proposed technique.

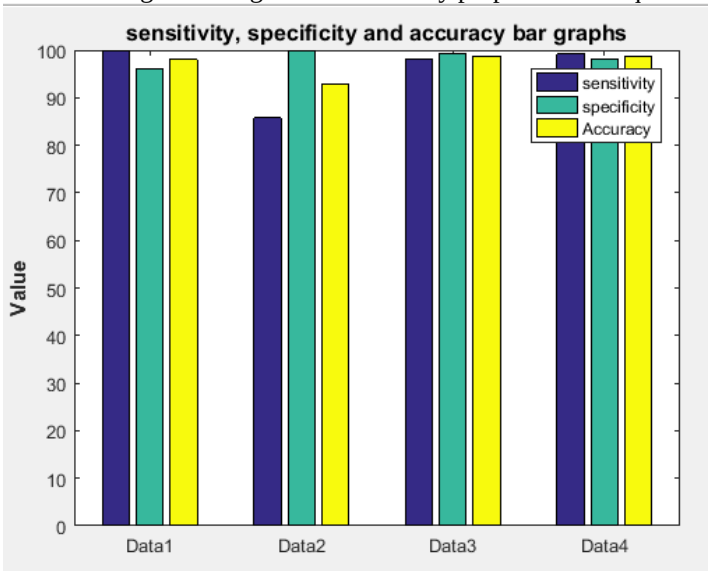

Figure 6: Figure showing bar graphs for the database images with sensitivity, specificity and accuracy parameters.

VII. CONCLUSION

Computer analysis and image processing are suitable tools which supports quantitative medical diagnosis.In dermatology, the lesions for skin cancer are separated into melanoma and non-melanoma. Because of fast course of the disease, early diagnosis is an essential factor that increases chances of cure. So computer based methodsare developed for dermatological images. For effective results and information of various stages of the lesion the features of that particular area is required.So the feature extraction depends on the region which is detected. The effectivesegmentation algorithm is required which can detect the skin melanoma pixels in the input image. In this work, an algorithm has been proposed which detects the pixels of melanoma region and normal skin. In proposed work, space complexity of intensity values has been reduced by pre-segmentation results from Gaussian mixtures posterior algorithm. In this algorithm some candidates are choose from different regions of the images which have different intensity values and then from the chosen placesGaussian models have been built by taking their neighborhood pixels. At the end to get final segmentation resultsneural network based training and testing has been implemented. Experimental results show that the proposed algorithm gives 97% accuracy results on the tested database images.

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