Improving Image Analysis System for the Detection Skin Cancer with Dermoscopy Images.

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***Abstract*-Skin cancers are the most common form of cancers in humans. It is a deadly type of cancer. Skin cancer may be Melanoma, Basal and Squamous cell carcinoma among which Melanoma is the most precarious. It is compulsory to recognize it in its early stage for its proper cure. To detect the skin cancer in its early stage an image analysis system has been developed with efficient algorithms. The image analysis module contains image acquisition, hair detection and exclusion, lesion segmentation, feature extraction, and classification. The dermoscopy image of skin cancer is taken and it is subjected to various pre-processing for noise removal and image enhancement. Then the image is undergone image segmentation using thresholding. There are certain features unique for skin cancer regions. Such features are extracted and given as an input to Probabilistic neural network (PNN) classifier. It classifies the given data set into Melanoma or BCC or SCC.**

Keywords- Image segmentation, neural network, Skin cancer, Thresholding.

1. INTRODUCTION

Skin Cancer is the cancer affecting the skin most common type of cancers are melanoma, basal cell carcinoma ,squamous cell carcinoma and melanoma. Research has shown that there are numerous types of skin cancers. Recent studies have shown that there are approximately three commonly known types of skin cancers. These include melanoma, basal cell carcinoma (BCC), and squamous cell carcinomas (SCC). However, melanoma has been considered as one of the most hazardous types in the sense that it is deadly, and its prevalence has slowly increased with time. Melanoma survival rates are lower than that of non-melanoma skin cancer. The death due to melanoma is increasing at an alarming rate of 3% per year. The death rate due to skin cancer can be reduced at higher rate by early detection. One of the major tools to detect skin lesion is dermoscopy. Dermoscopy refers to the examination of skin using skin surface microscopy. Dermoscopy is mainly used in the diagnosis of pigmented skin lesions. The colors found in pigmented skin lesions are black, brown,
red, blue, grey, yellow and white. Using dermoscopy, the lesion pigmentation is evaluated in terms of color and structure. The pigmented skin lesions are of different types. Diagnosis helps in easy and efficient detection of melanoma.

2. RELATED WORKS

Karargyris et al. have worked on an advanced image-processing mobile application for monitoring skin cancer The authors presented an application for skin prevention using a mobile device. An inexpensive accessory was used for improving the quality of the images. Additionally, an advanced software framework for image processing backs the system to analyze the input images. Their image database was small, and consisted of only 6 images of benign cases and 6 images of suspicious case [1].

Doukas *et al.* developed a system consisting of a mobile application that could obtain and recognize moles in skin images and categorize them according to their brutality into Melanoma , nevus, and benign lesions. As indicated by the conducted tests, Support Vector Machine (SVM) resulted in only 77.06% classification accuracy [2].

Massone *et al.* introduced mobile tele dermoscopy: melanoma diagnosis by one click. The system provided a service designed toward management of patients with growing skin disease or for follow-up with patients requiring systemic treatment. Tele dermoscopy enabled transmission
of dermoscopic images through e-mail or particular web-application. This system lacked an automated image processing module and was totally dependable on the availability of dermatologist to diagnose and classify the dermoscopic images. Hence, it is not considered a real-time system [3].

Wadhawan *et al.* proposed a portable library for melanoma detection on handheld devices based on the well-known bag-of-features framework. They showed that the most computational intensive and time consuming algorithms of the library, namely image segmentation and image classification can achieve accuracy and speed of execution comparable to a desktop computer. These findings demonstrated that it is possible to run sophisticated biomedical imaging applications on smart phones and other handheld devices, which have the advantage of portability and low cost, and therefore, can make a significant impact on health care delivery as assistive devices in underserved and remote areas. However, their system didn't allow the user to capture images using the smartphone [4].

Ramlakhan and Shang introduced a mobile automated skin lesion classification system. Their system consisted of three major components: image segmentation, feature calculation, and classification. Experimental results showed that the system was not highly efficient, achieving an average accuracy of 66.7%, with average malignant class recall/sensitivity of 60.7% and specificity of 80.5% [5].

3. METHODOLOGY

The fig.1 shows the methodology for the diagnosis of skin lesions.

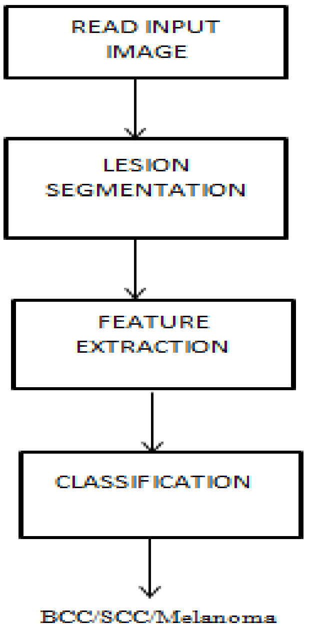

Fig.1 Flow chart for proposed image analysis system

A.PreProcessing

The Dermoscopic Image in digital format is subjected to various Digital Image Processing Techniques. Usually the image consists of noises in the form of hairs, bubbles etc. These noises cause inaccuracy in classification. In order to avoid that, images are subjected to various image processing techniques. Morphological closing is used in excluding hairs in dermoscopic images. The bicubic interpolation is followed by bicubic interpolation to fill the hair gap positions. The wiener filter is applied to the excluded image to smoothen the image and finally the image is enhanced using morphological operation.

B. Lesion Segmentation

Segmentation removes the healthy skin from the image and finds the region of interest. Usually the cancer cells remains in the image after segmentation. Segmentation used is Otsu's Segmentation. Otsu's segmentation is fully unsupervised. Thresholding often provides an easy and convenient way to perform this segmentation on the basis of the different intensities or colors in the foreground and background regions of an image. The input to a Thresholding operation is typically a grayscale or color image. After segmentation, the output is a binary image. Segmentation is accomplished by scanning the whole image pixel by pixel and labelling each pixel as object or background according to its binarized gray level.

C. Feature Extraction

At this stage, the important features of image data are extracted from the segmented image. By extracting features, the image data is narrow down to a set of features which can be used to classify different types of skin lesions. The extracted features are mean, standard deviation and shape features. The mean and standard deviation describes the skin pigmentation between the lesion and surrounding skin. The pigment transition describes the transition between the injury and the setting points of skin on each side that is the level of steepness. To portray the lesion shape best- fit ellipse is used. It's also used in calculating the degree of irregularity.

D. Probabilistic Neural Network Classifier

A probabilistic neural network (PNN) is a feed forward network, which was derived from Bayesian network and a statistical algorithm called Kernel Fisher discriminant analysis. The architecture of PNN is shown in fig.2. All PNN networks have four layers. The first layer is input layer. It is one neuron in the input layer for each predictor variable. In the case of categorical variables, *N*-1 neurons are used where *N* is the number of categories. The input neurons (or processing before the input layer) standardize the range of the values by subtracting the median and dividing by the interquartile range. The input neurons then feed the values to each of the neurons in the hidden layer. The second layer is hidden layer. It has one neuron for each case in the training data set. The neuron stores the values of the predictor variables for the case along with the target value. When presented with the *x* vector of input values from the input layer, a hidden neuron computes the Euclidean distance of the test case from the neuron‘s center point and then applies the kernel function using the sigma value. The resulting value is passed to the neurons in the pattern layer. The third layer is pattern layer or summation layer. It is actual target category of each training case is stored with each hidden neuron. The weighted value coming out of a hidden neuron is fed only to the pattern neuron that corresponds to the hidden neuron‘s category. The fourth layer is decision layer.

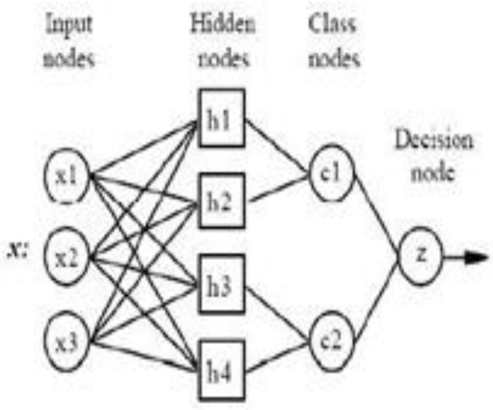

Fig.2 Architecture of PNN

4. EXPERIMENTAL RESULTS

In this section experiments are conducted to verify the performance of the proposed system. The dataset contains 200 dermoscopic images of lesions including Melanoma, BCC and SCC. They were undergone preprocessing and segmentation. After segmentation the features were extracted and are given as input to probabilistic neural network. The parameters such as sensitivity, specificity and accuracy were calculated to measure the performance of PNN classifier. The above parameter can be calculated as:

Sensitivity=TP/(TP+FN) (1)

Specificity=TN/ (TN+FP) (2)

Accuracy= (TP+TN)/ (TP+TN+FP+FN) (3)

Classifier	Sensitivity (%)	Specificity (%)	Accuracy (%)
PNN	72	76	80

Table 1.Evaluated parameters

5. CONCLUSION

An image analysis system has been designed with efficient algorithms to detect the dermoscopy images. The diagnosing methodology uses digital image processing techniques and PNN classifier for the classification of different types of skin cancer. Dermoscopic images were collected and they are processed by various Image processing techniques. The cancerous region is separated from healthy skin by the method of segmentation. The unique features of the segmented images were extracted .Based on the extracted features, the images were classified as Melanoma or BCC or SCC using PNN classifier with the accuracy of 80%, sensitivity of 72% and sensitivity of 76%.

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