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Adaptive Neuro Fuzzy Classification of Skin Lesion

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Abstract - In this paper,an unusual way for border detection,feature extraction and classification of skin lesion is proposed for both the mealanocytic skin lesion (MSLs) and nonmelanocytic (NMSLs).There are lots of methods to recognize between melanoma and nevus ,that are both categorized as MSL.But bascal cell carcinoma and sebrotic keratosis are categorized as NOMSL.In this paper we extracted the border between the tumour and the surrounding normal skin.The algorithm used for the border detection is mean shift algorithm.This computer aided method calculates 828 candidate features which are grouped into color,subregion,and texture.We introduce an algorithm for the classification of skin lesion is Adaptive Neuro Fuzzy Inference Systems .The result have high accuracy when compare with the layered model and flat model.

Index Terms – MSL, NOMSL, Neuro, Fuzzy.

1. INTRODUCTION

Skin is the largest part in a human body which covers the muscles,bones and all other part of the body.It is of greater importance because any altereation in its function might affect the body.Mostly skin is the part which is expose to disease and infection.so a better attention should be given for their protection.The infected area in skin is called lesion area. Some primary symptoms for diseases like chickenpox,melanoma are skin lesions.In the new era diseases are mostly diagonized with the help of technology which help inexperienced praticoners for their diagnosis(dermeatoligist).skin cancer detection is made more easier by in-cooperating digital image process without any physical contact with skin.Due to these significance computer aided diagnosis system has become a major area of research in medical field.Various literature have been propsed on classification of skin lesion [1].It prevents a system of method used in the classification of pigmented skin lesion in dermoscopy.[2] introduce an evolution stratergy based division algorithm to find the lesion area within a region.[3] introduce two new approach to the skin segmentation. Another method is used based on neural network edge detection method.[4] for automatic segmentation in dermoscopy image water shed algorithm is proposed . [5] by initializing the randomwalker algorithm an automatic segmenting skin lesion is used.

Accurate diagnosis of skin cancer is more difficult due to their confusing appearance.Even the similarly categorized skin lesions like melanoma and nevi distinguish easily. Even with the help of advanced dermoscopic techniques, expert dermotolgist is unable to accurately diagnose melanoma where their rate falls from 75-84%. Though biopsy a definite diagnosis foe the detection and identification of skin lesions they are not commonly used because of their common disadvantage of metastasis, it is only recommended only if patient undergo surgical procedure within a month[6].

Researchers develop noninvasive computer aided methods to distingiush melanoma from nevi using dermoscopy image without noninvasive procedure which improve the quality of life of patient by avoiding unnecessary biopsy [7,8.13,14]. Usually all these method consist of different steps which are 1)Boreder Detection 2) Feature Extraction and 3)classification. In which the border detection process is the most essential one which finds the border of the tumor in the dermoscopy image which helps in precise classification of skin lesions.Several other methods have been proposed like SRM[16]hybrid threshold, threshold fusion and many others. Next two border detection , the feature extraction process explains the texture information counter shape and color statistics in general wavelet coefficient that capture color and shape information have also be enquired. At last the extracted information about the image features determines the type of skin lesion and hence classified. The mostly used classifier and linear distinct classifier [10] KNN[11], artificial neural network and SVM.Apart from all these steps investigators are developed an automated classification method also. Even though these classification have many limitations, studies report that these are superior than experts [12] achieved 93.3%SE and 92.3% SP.

The proposed literature mainly focus on only four types of diseases mainly melanoma, nevi, BCC,SK. The proposed method describes about the skin lesion region, color and

texture of the skin affected. Another important point to be noted is about learning algorithms. An improvement in this area is made by gathering information from many classifier and also by fusing the decisions from multiple classifier is recently gaining more importance so in the proposed work we have used ANFIS classifier.

2. DATA SET

In this study, we used 968 digital dermoscopy images categorized into four types: melanoma, nevus, BCC, and SK. The details are given as follows.

1) *Melanoma:* 105 images (30 from Keio University Hospital and 75 from the University of Naples and Graz), a malignant melanocytic tumor (MSL), the most fatal skin cancer.

2) *Nevus:* 692 images (448 from Keio University Hospital and 244 from the University of Naples and Graz), a benignmelanocytic tumor (MSL), often difficult to differentiate from melanomas.

3) *BCC:* 69 images (20 from Keio University Hospital and 49 from TokyoWomen'sMedical University), a malignant non-melanocytic tumor (NoMSL), the most common skin cancer.

4) *SK:* 98 images (42 from Keio University Hospital and 56 from Tokyo Women's Medical University), a benign non-melanocytic tumor (NoMSL), which commonly occurs in the elderly and is sometimes confused with melanomas.

These images have different resolutions ranging from 512 × 384 to 3641 × 2732. The diagnosis of the skin lesions was determined by histopathological examination or clinical agreement by several expert dermatologists.

3. PROPOSED METHOD

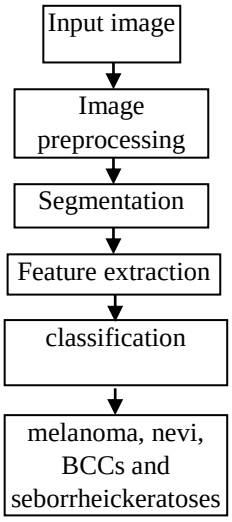

Figure 1: Overall process of proposed method

The proposed methodology is to design and develop a computer vision based system for segmentation and classification of skin lesions along with extraction of dicriminating set of features from skin lesions for efficient classification. The overview of the proposed method is shown in the figure 1.

3.1 Border Detection

Each skin lesion image describes about the border between the tumour and the surrounding normal skin area. Result classification is based on accurate border detection. Melanocytic skin lesions are better explained by conventional automated methods. In this study, the border imaging is done with help of mean shift clustering algorithm. The mean shift algorithm is a nonparametric clustering technique which does not require prior knowledge of the number of clusters, and does not constrain the shape of the clusters.The algorithm outperformed other state-of-the-art methods (dermatologist-like method [17], SRM [18], hy-bridthresholding [19], k-means++[32], and JSEG [33]) for NoMSLs and showed equivalent or better performance for MSLs.

3.2. Feature Extraction

This section explains about the features which help in categorizing the skin lesion images. In this work the lesion areas are described with the help of color, texture and sub region features. The statistical explanation for color features are mostly explained with the help of mean, standard deviation, variance and skewness and also over the individual channel and segmented lesion over the individual channel is provided with the help of two different color spaces RGB and HSV

Angle-wise and distance wise extraction procedure is used for sub region related features. Angle-wise feature procedure is as follows, firstly the angle of image is detected followed by detection of edges for the segmented image using canny edge detection method and finally subtract angle with the edge of the image.

A set of statistical texture descriptiors based on grey level co-occurance matrix quantify the texture present in a lesion(GLCM) which is the well known and widely used method for texture computation method. Cooccurance texture features are extracted from image into two steps. First order texture measures comprises of statistical calculation from the orginal image values such as variance and do not consider pixel neighbor relationship, where as the second order measures the relationship between two groups of pixel in orginal image.

3.4 Classification

For classification Adaptive Neuro Fuzzy Inference Systems is used, Adaptive network based fuzzy inference system (ANFIS) is a neuro fuzzy technique where the fusion is made between the artificial neural network (ANN) and the fuzzy inference system (FIS). Based on the differences between the specification of the consequent part and the defuzzification schemes, several types of FIS have been proposed. ANFIS is a network structure consisting of a number of nodes connected through directional links. Each node is characterized by a node function with fixed or adjustable parameters. The learning or training phase of a neural network is a process to determine parameter values to sufficiently fit the training data. The basic learning rule is based on the well - known back-propagation method, which seeks to minimize some measure of error, usually the sum of squared differences between network's outputs and desired outputs. ANFIS is a network structure consisting of a number of nodes connected through directional links. Each node is characterized by a node function with fixed or adjustable parameters. The learning or training phase of a neural network is a process to determine parameter values to sufficiently fit the training data. The basic learning rule is based on the wellknown back-propagation method, which seeks to minimize some measure of error, usually the sum of squared differences between network's outputs and desired outputs. In first-order TS's system, a typical rule set with two fuzzy rules and four membership functions can be expressed as:

- Rule 1: If x is A1 and y is B1, then f1 = p1x + q1y + r1
- Rule 2: If x is A2 and y is B2, then f2 = p2x + q2y + r2

Where x and y are inputs; f1 and f2 are output levels. It should be noted that the possible number of rules for an ANFIS model with two inputs and two membership functions is four while in the above equation just two rules are considered for simplicity in explanation. This means that the two cases "if x is A1 and y is B2" and "if x is A2 and y is B1" are not considered.

4. SIMULATIONS RESULTS

The performance of the classification is evaluated in terms of classification accuracy, precision, recall and Fmeasure from the confusion matrix of classification. The measures are computed by using the equations described below with the following conventions. TP (True Positive) =Positive samples classified as positive. TN (True Negative) = Negative samples classified as negative. FP (False Positive) = Negative samples classified as positive. FN (False Negative) = Positive samples classified as negative.

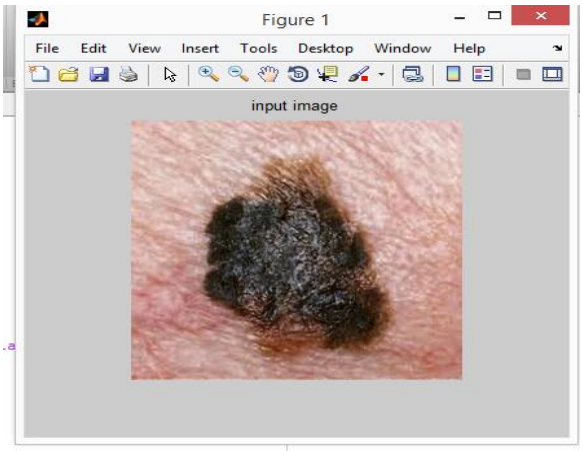

Figure 2: Input Image Selection

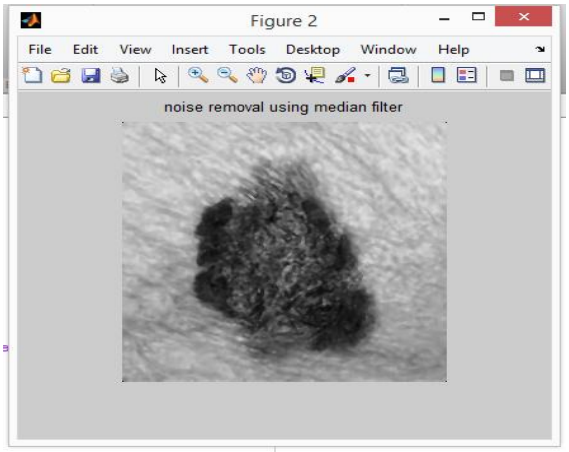

Figure 3: Image after noise removal

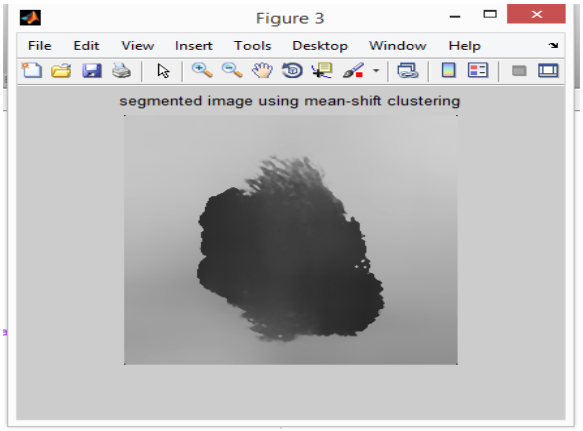

Figure 4: segmented image

Sensitivity (*SN*)

Sensitivity is the probability of the actual positive classes which are identified correctly.

$$SN = \frac{TP}{(TP + FN)} * 100$$

Figure 5 represents the sensitivity comparison among the existing algorithms with proposed classification algorithm. The graph shows that the sensitivity rate comparison of existing and proposed classification algorithm results based on two parameters such as -sensitivity and number of given no. of Input images.

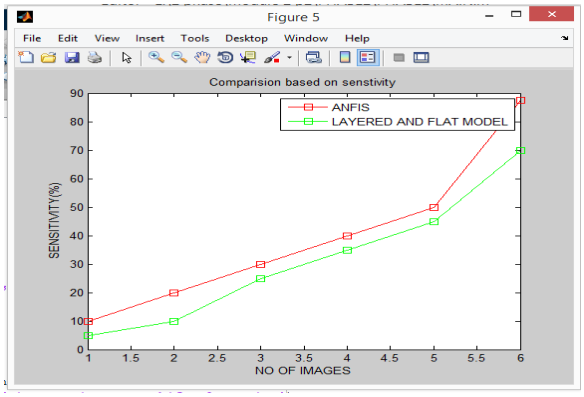

Figure 5: Sensitivity Rate

Specificity(SP)

Specificity is the probability of actual negative classes which are identified correctly.

$$Sp = \frac{TN}{(TN + FP)} * 100$$

The Figure 6 clearly describes the proposed algorithm has a high specificity rate compare to the previous classification algorithm. The graph shows specificity rate comparison of both the proposed and existing methods.

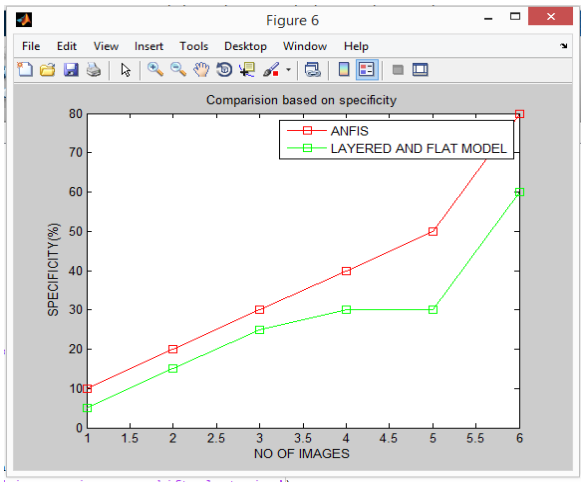

Figure 6:specificity rate

Accuracy (A)

Accuracy is the percentage of correct classification of$v$ cases and healthy patients.

$$A = \frac{(TP + TN)}{(TP + FN + FP + TN)} * 100$$

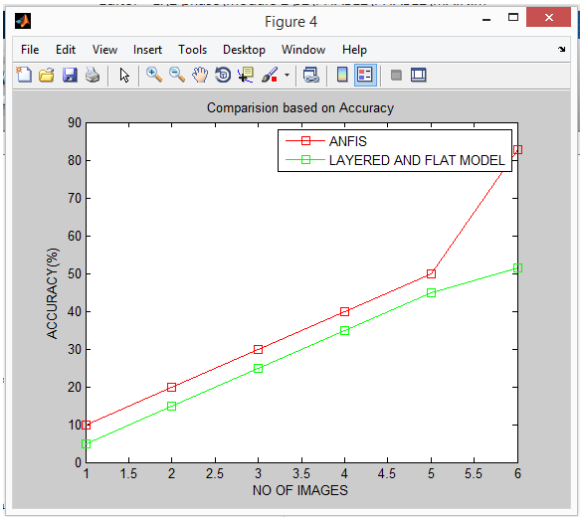

Figure7: Accuracy rate

The Figure 7 shows the proposed and exiting classification algorithms accuracy rate. The graph will shown the proposed classification algorithm has the high classification accuracy rate than existing classification algorithm.

5. CONCLUSION

In this work we proposed a method to classify the skin lesions among melanomas, nevi, BCC, and SK. Firstly we extracted the border between the tumor and the normal skin. Later the color, subregion and texture features are extracted. For the classification we introduce a new method called Adaptive Neuro Fuzzy Inference Systems(ANFIS). We estimate with the 964 dermoscopy images. Even though five types of diseases are focused one among them is no where used for classification though its having an equal important that of others. The superiorty check of proposed study is done with the help of a comparative study along with other contemporary works. Hence it is concluded that the proposed method in this work can be used as supplementary tool by the experts to diagonize skin diseases.

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