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Innovative Technique of Segmentation and Feature Extraction for Melanoma Detection

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***Abstract*—** This paper presents a new technique of segmentation and feature extraction for classification of melanoma and non-melanoma. Both segmentation and feature extraction is done by the concept of average value since average is the number closer to every number. Here we have also compared K-means segmentation technique with new the technique. In experimental part we evaluate 80.897% average accuracy through neural network classification.

***Keywords*—** Segmentation, Global + Local Segmentation, Center Starting Feature Extraction, K-means Segmentation, Feature Extraction.

I. INTRODUCTION

Melanoma is a type of skin cancer and is the most dangerous disease. This initially shows slow growth which is put under latent stage but later growth rate becomes rapid causing overcrowding and damage to normal cells [1]. Susceptibility to cancer depends upon familial factors -smoking, chemical and environment factors. Various lesions present on skin like moles, freckles, birthmark, etc. have potentiality to be cancerous.

Early diagnosis is one of the major issues for dermatologists, if diagnosed at early stage it can be cured [1]. Earlier biopsy and histopathological studies of tissue are common methods. These uses ABCD rule [5] for detection of Melanoma, where (A) Asymmetry: common moles are symmetrical. This means that if we draw a line down the center of a mole the two halves will look alike. Early melanomas are asymmetrical, (B) Border Irregularity: early melanomas often have uneven borders. They may have notched edges, (C) Color Variation: common moles are usually of single color like brown/black. Early melanomas are often of varied shades/color. (D) Diameter: the diameter of melanoma is usually larger than that of moles. Early melanoma generally grows to the size of ¼ inch diameter.

As technology grows, these manual method turns into machine one and used with the help of computers for the melanoma detection. With the help of image processing diagnosis process becomes easier and fast [3]. In image processing, we use segmentation process to partition the image between affected and non-affected part of skin cancer and then we extract features of segmented image which gives us feature vector which are helpful in classification process. Stanley et al. [9] uses the color analysis concept but change in color stops after some time. For skin cancer detection Ercal et al. [10] uses A, B and C concept. Then after M.Messadi, A. Bessaid and A. Taleb-Ahmed [5], uses ABCD rule and neural network. But after the research progress, it is found that there are certain moles called dysplastic moles [2] which have similar features as that of melanoma but they are not melanoma, so based on ABCD rule it is difficult to find whether it is melanoma or not.

So the research turns towards texture extraction or feature extraction. Now a days, Texture analysis is an important area of machine learning. With the help of this, machine learns the characteristics of data [12]. Rashi Goel and Saranjeet Singh [11], uses the concept of texture descriptor, Gray Level Co-occurrence Matrix (GLCM), recognize melanoma but in this the size of co-occurrence matrix is large enough to evaluate. Priyadarshini D and Rengini D [8], uses the concept of Local Binary Pattern (LBP), which recognize skin cancer. Nannie et al. [13] uses the concept of LBP and Huang et al. [14] done a survey of LBP for facial image analysis.

In this paper we introduce a new method for melanoma segmentation and feature extraction, we have also compared

k-means segmentation with new method of segmentation named Global + Local Segmentation.

After this introductory part, we introduce the proposed methodology in sec. II which discuss all necessary steps. In sec. III, experiment and simulation works presents the dataset formation and result analysis. Then after sec. IV, gives the conclusion.

II. METHODOLOGY

In this paper new technique of segmentation and feature extraction are described. Figure1 show steps for classification of melanoma. Three fold cross validation is used for validation purpose.

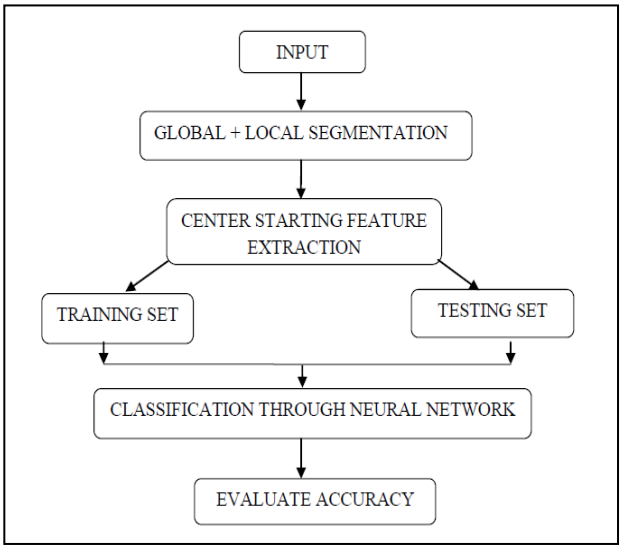

Fig. 1: Proposed Method

A. Segmentation

Segmentation draws a line between affected and non-affected part and removes unaffected part of skin from image [6].
Two segmentation techniques are used here.

1) K-mean Segmentation.
2) Global + Local Segmentation.

1) **K-mean Segmentation:** In this k=2(here) clusters one for affected part and other for non affected part. The procedure for the k-mean technique [15] is as follows:
   1) Find the distance between the observation and cluster means.
   2) Assign the instance or observation to the cluster with which the distance is minimum.
   3) Calculate the new mean of the cluster after the observation is added.
   4) Repeat the steps till a pre-defined threshold is met.

   This method takes time to do segmentation of 157 images of our dataset. This also includes some non affected part in segmented images, which decrease the accuracy.

2) **Global + Local Method**

On the analysis of images, we find affected part is darker than skin part in gray scale image, so we conclude that affected part values are lesser than skin part values. On this basis we build a method named Global + Local Method.
Global + Local Method:

1. Read the image, convert it into gray scale image and then convert it into double.
2. Find Global mean i.e. mean of whole image say M_G.
3. Find every local mean say M_L of image in 3X3 window and compare M_G with M_L put lower value in new matrix say X_{AVG}.
4. In this way we have a matrix X_{AVG} of minimum mean of same size as that of image.
5. Compare value of X_{AVG} with pixel values in 3X3 window of image if value greater than X_{AVG} then take 1 else 0, move window one by one to whole image.
6. In this way a mask of 0 and 1 is created.
7. Check value of mask if value is 0 assign original image value else 255, this will give segmented image.

B. Feature Extraction

There are some important features that distinguish skin cancer. Feature extraction extracts these important features and helps in distinguishing melanoma from non-melanoma [7].

We analyze images of skin cancer, we find that the affected part is present at or near the centre and all other portion of skin part is not needed in feature extraction of melanoma. On the basis of this we build a new concept where feature extraction starts from the centre.
For this we give algorithm:

1. Find the size of segmented image.
2. Divide size by 2, we get centre pixel location.
3. We move in circular path as shown in figure below.
4. We take average of 8 pixel values plus central value if first time else last pixel i.e. 8^{th} one of previous loop become center for present ones present in circular order.
5. Then check these 9 values individually, if they are greater than average value assign 1 else 0.
6. In this way we get pattern of 0's and 1's convert it to decimal and store it in new matrix represents feature vector.
7. Move in circular manner and calculate pattern as mentioned in above step for whole image until loop

condition is true.

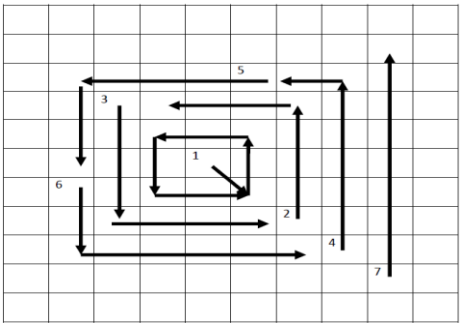

Figure 2: Circular path

C. Classification

Images either belongs to melanoma category or non-melanoma category are classified with the help of classification process [4]. Here we have used neural network for this purpose. Figure 3 shows neural network architecture. Neural network has three layers (i) input layer, (ii) hidden layer and (iii) output layer.

Input layer is a matrix of 119X157, representing static data 157 samples of 119 elements.
Hidden layer: Define a pattern recognition neural network we have taken 10 neurons in hidden layer.
Output layer is a matrix of 2X157, representing static data 157 samples of 2 elements.
Three kinds of samples are taken:

1. Training: These are presented to the network during training, and the network is adjusted according to its error.
2. Validation: These are used to measure network generalization, and to halt training when generalization stops improving.
3. Testing: These have no effect on training and so provide an independent measure of network performance during and after training.

We have taken three fold for validation purpose by changing the value of training, validation and testing samples.

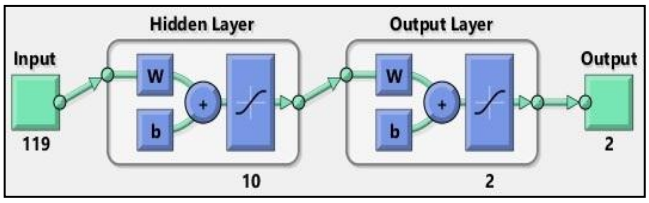

Figure 3: Neural Network Architecture

III. RESULTS AND DISCUSSION

A. Database Peparation

For the experiment, we have taken melanoma and non-melanoma images from internet sources. In total we have 157 images out of which 76 are melanoma and 81 are non-melanoma. For feature extraction we have resized segmented images to 32X32.

B. Result Analysis

K Mean Segmentation takes long time to do segmentation of 157 images of our dataset. This is because for one image Euclidean distance of all pixel values are compared with mean of all clusters (here 2) and assign the pixel value to the cluster with whom distance is minimum then new cluster mean is calculated and compared with old mean, this process goes until difference of new mean and old mean becomes zero. Therefore for 157 image dataset it takes much time. This also includes some unaffected part in segmented images as shown in fig.4 below since in starting of segmentation random values are assigned to cluster mean variables, which decrease the accuracy level shown in table II of result analysis.

Algorithm finds minimum average from both local and global area of image which is compared with every pixel value then smaller values are taken and all other are replaced by 255 so this give segmented image as shown in figure 4 and 5.

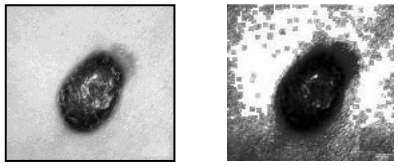

Figure 4: K-means Segmentation

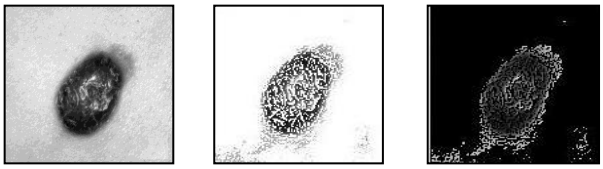

Figure 5: Global + Local Segmentation

We have started from center as on analysis we find affected part is present at or near the center, this give us the concept that there is no need to extract the features of whole area. Average value is compared with every pixel, since average is a value close to every value this gives pattern with minimum difference which is then coded and fed into feature vector.

In case of feature extraction without segmentation, we have both affected and skin part so pattern of both are recognized and fed into feature vector. Due to both part (skin and affected), values are not much unique when compared to other images feature vector therefore accuracy decreases.
In case of feature extraction with global + local segmentation, only affected part features are fed into feature vector, so accuracy increases.

Table 1: Average Classification Accuracy Of Center Starting Feature Extraction Techniques With Global + Local Segmentation

Training/Validation/ Testing	Global +Local Segmentation	K-Means Segmentation	Without Segmentation
(109,24,24)	85.23	74.42	64.79
(95,31,31)	80.84	72.97	71.88
(79,39,39)	76.60	69.58	66.46

Table 2: Average Accuracy (Table 1) Of Center Starting Feature Extraction Techniques Using Different Segmentation

Segmentation Technique/Feature Extraction Technique	Centre Starting Feature Extraction
Global + Local Segmentation Technique	80.897
K-Means Segmentation	72.319
Without Segmentation	67.708

IV. CONCLUSION AND FUTURE SCOPE

Segmentation method presented here is new and simplest one based on analysis of affected part of image, shows good result as shown in figure presented in experiment and simulation section.

Unique features of segmented images are extracted using new technique named centre starting feature extraction where we not extract features of complete image since affected part is present at or near the centre this makes feature vector small and less complex. Result analysis by centre starting feature extraction using global + local segmentation method is presented in table 2 the images are classified with average accuracy 80.897%. Figure 6 shows a comparative analysis of feature extraction with and without segmentation.

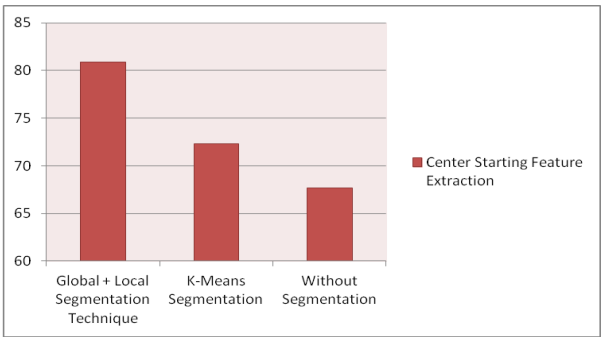

Figure 6: Average of Centre Starting feature extraction on different segmentation techniques

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