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Skin Lesion Detection Using Anisotropic Mean Shift Based Clustering Algorithm

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Abstract—This paper presents an application of fuzzy c-means(FCM) clustering algorithm for skin segmentation. An anisotropic mean shift based FCM algorithm is used by estimating the local gradient of similar pixels iteratively. The estimated local gradient are used to temporal coherence which reject the irregular shapes and noise in skin lesion image. The Mahalonabise distance is used as a threshold for segmentation. Dermoscopic images show that this method accurately and efficiently detects the borders and area of skin lesions.

Keywords- Fuzzy c-means (FCM) clustering algorithm, Mahalonabise distance, Dermoscopic images, local gradient, segmentation.

I. INTRODUCTION

Melanomas can occur anywhere on the skin, but they are more likely to start in certain locations. The neck and face are other common parts of body. Maligant Melanoma is one of the most rapidly increasing cancers in the world [1]. Early diagnosis of melanoma can be cured. Dermoscopy is a noninvasive skin imaging technique. Automatic border detection of lesions is the first step in the automated or semi-automated analysis of dermoscopy images. Image segmentation can be defined as the grouping of similar pixels (i.e. lesion and non- lesion pixels) in a parametric space, where they are associated with each other in the same or different images. Fuzzy c-means (FCM) is a segmentation algorithm that is based on clustering similar pixels in an iterative way where the cluster centers are adjusted during each iteration [2]. Due to its iterative nature the computational cost of the algorithm is relatively high compared to other segmentation techniques. Fig.(1) shows the block diagram for skin lesion. Digital images of skin cancer are collected from dermoscopy. The median filter performs enhancement of image, noise removal, edge highlighting, sharpening, change in image that resizing to 512×512.

Segmentation method has properties as follows: Initial segmentation - A threshold value is determined from the average intensity of high gradient pixels in the obtained intensity image. This threshold value is used to decide approximate lesion boundaries. Region refinement a region boundary is refined using edge information in the image. This involves initializing a closed elastic curve at the approximate boundary, and shrinking and expanding it to the edges in its neighborhood. Sirisha Konakala [3] has proposed method which identifies the edge regions of the wound part that can help clinicians in their diagnosis. It describes the use of threshold values and FCM clustering algorithms for detection of wounds on the skin. It is able to take both the distributions of color space and the spatial interaction between surrounding pixels during clustering.It involves classification of different image pixels into skin and non skin techniques on the basis of pixel color. The drawback of this algorithm is slow training processes to achieve stabilization condition. M.S. Mallikarjunaswamy [4] proposed segmentation algorithm using radial search technique to extract the t border of dermoscopy images having lesions. In radial search algorithm first pixels of image are converted to

form an intensity mole image. Then calculate center of intensity mole point at equal angles of (360/n) degrees. This algorithm detectes the weak boundaries of melanoma.

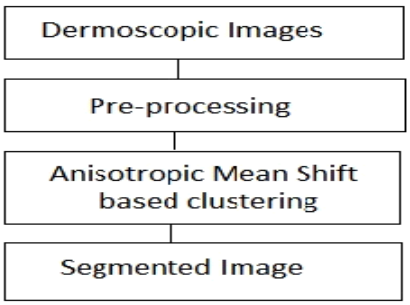

Figure 1. Block diagram for dermoscopy image segmentation

Nilkamal S. Ramteke [5] proposed scheme using wavelet transformation for image improvement, denoising and for histogram analysis. In this algorithm mean value of image is calculated and pixels having value below mean are assigned as white pixels on binary image. The darker pixels than mean are considered as part of melanoma skin cancer. In this paper, a new mean shift based FCM algorithm is used which requires less time than established techniques, since cluster centers are quickly calculated. The paper is organized as follows: In Section II, the anisotropic mean shift based FCM approach is described in Section II. Section III presents result analysis. Finally, conclusions is given in Section IV.

II. ANISOTROPIC MEAN SHIFT BASED FCM

Fuzzy partitioning is carried out through an iterative optimization of the objective function with the update of membership μ_{ij} and cluster centers c $_j$ by,

$$Jm(U,V) = \sum_{j=1}^{N} \sum_{j=1}^{C} \text{uij d\^{}2(Xj V i)}$$

where, U = Fuzzy membership function
V = Set of cluster centroid
N = Represents no. of feature vector
C = No. of clusters
m = Weighting exponent
X = x1 , x2 , x3 , ..., xn
The membership function is expressed as:

$$Uij = \frac{1}{\sum_{k=1}^{c} \frac{d(Xj, Vi)}{d(Xj, Vk)}^{\left(\frac{2}{m-1}\right)}} \qquad (1)$$

The Cluster center determined as:

$$V_i = \frac{\sum_{j=1}^{N} (u_{ij})^m x_j}{\sum_{j=1}^{N} (u_{ij})^m} \qquad (2)$$

Where, i = 1, 2, ... C

Degree of fuzziness is given by:

$$d^2(Xj, Vi) = \left| |Xj - Vi| \right| \qquad (3)$$

where ||.|| = Mahalanobise distance.

Mean shift based techniques is capable of estimating the local density gradients of similar pixels. These estimated gradient are iteratively performed so that all pixels can find similar pixels in images [6]. The temporal coherence is reduced in the presence of irregular structures and noise. This reduced coherence may not be properly detected by radially symmetric kernels and thus, an improved mean shift approach, anisotropic kernel mean shift [6] , provides better performance. Anisotropic mean shift is used to modulate the kernels during the mean shift procedure. The objective is to keep reducing the Mahalanobise distance so as to group similar samples as much as possible

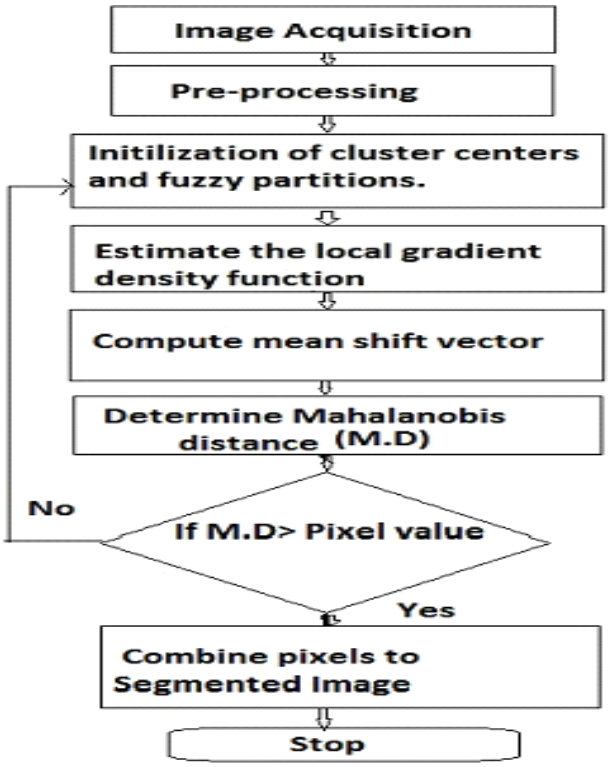

Figure2. Flow chart of dermoscopic image segmentation

The anisotropic mean shift based FCM (AMSFCM) involves in the following steps.

1) Initialize the cluster centers C_i . Let the iteration count t=0

2) Initialize the fuzzy partitions μ_{ij}.

3) Increment t= t+1 and compute C_i using for all clusters .

4) Update μ_{ij} using this is an FCM process.
5) For each pixel X_i one needs to estimate the density with anisotropic kernels and related color radius using 8-10. For simplicity, can just apply variances at the diagonal items with other zero components.
6) Calculate the mean shift vector and then iterate until the mean shift, is less than 0.01 considering the previous position and a normalized position change.
7) Merge pixels that possess less Mahalanobise distances than the predefined thresholds.

III. RESULT ANALYSIS

Dermoscopic images are collected from Saraswati hospital, Ambajogai. Originally these dermoscopic images have 2450 x1705 pixels. These images are then resized to 512 x 512 pixels. Fig(2). shows the segmentation algorithm.

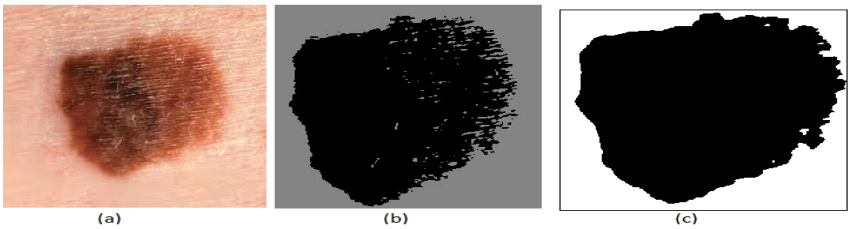

Figure3. (a) Original image (b) pre-processed image (3) Segmented image

Fig (3) shows the segmented image after pre-processing operation. Fig (4) shows the extracted borders of different skin lesion images. It helps dermatologist for detection of exact borders of affected part and size of skin lesions.

Figure4. Original image (a ,b) and Border Detected (c, d)

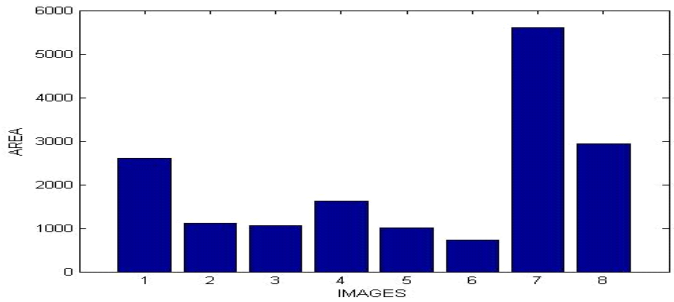

Figure 5. Bar chart of values of area.

IV. CONCLUSION

The C-means based algorithms are frequently used to segment medical images but are also computational intensive. In this paper we have used a new mean shift based fuzzy c-means segmentation algorithm. The method used a mean field term within the standard fuzzy c- means objective function. Based on a set of dermoscopic images, we have shown that the segmentation technique AMSFCM is capable of providing good segmentation. The border and area of the segmented image is detected to helps doctor for diagnosis of skin lesion patient.

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