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A Review of Segmentation Techniques on Melanoma Detection

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Abstract- In the current scenario focal point is on the development of CAD (Computer Aided Diagnosis) for dermoscopic images. In this paper, different kinds of segmentation algorithms are analyzed for automatic segmentation of skin lesions in dermoscopic images being evaluated. Among the implemented segmentation algorithms, border detection algorithm has achieved a better performance, when compared to others. Automatic border detection is one of the challenging tasks in dermoscopic images.

Key Words: Segmentation, Dermoscopy, Melanoma, Thresholding, Border.

I. INTRODUCTION

Segmentation is the method of separating a digital image into multiple ones. Segmentation is one of the primary steps in melanoma detection such as dividing the image into meaningful objects or regions [1]. In image processing, segmentation is one of the complicated tasks. To remove the affected lesion pigment from the healthy skin, segmentation is chosen.

Malignant melanoma is one of the critical types of cancer which is on the increase nowadays. Melanoma is adestructive one, when compared to other types of skin cancer. Melanoma can be diagnosed through the ABCDE rule physically, but not during early stage [4]. Several segmentation techniques need to be enhanced to detect melanoma earlier.

Dermoscopic images play a vital role in detecting melanoma. Dermoscopy is one of the key tools in diagnosis, since it has vivo, which observes the pigmented skin lesion in a apparently. Nowadays, the focus is on the improvement of CAD for dermoscopic images. One of the basic tasks in CAD is segmentation, which further leads to good classification in a quality manner.

Dermoscopy is one of the demanding diagnoses of melanoma by detecting them automatically with lesionborders. The segmentation method is said to be complete, by displacing or dislodging a set of regions uniquely with the corresponding object of the input. Segmentation is relatively difficult in dermoscopy where the lesion and skin have to be split. This difficult is due to the low contrasrt. Computer–aided diagnosis for detecting melanoma includes the following steps, shown in Figure: 1.

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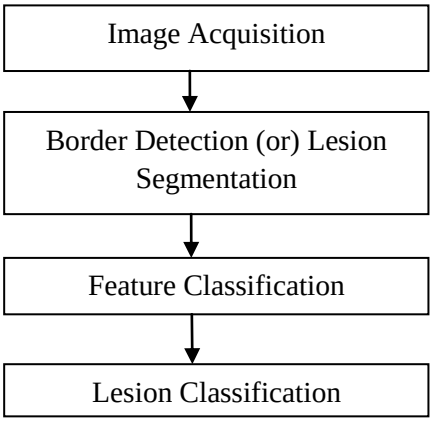

Figure: 1-Steps for Detecting Melanoma Using CAD

Even though the variation between the manual and automatic borders has been reduced, numerous techniques such as morphological filtering, Euclidean distance transform, and Iterative region growing and gradient information, etc. are used in automatic border detection.

II. SEGMENTATION

Segmentation is one of the complex tasks in image processing. To remove the lesion pigment from the healthy skin, segmentation technique is chosen. Different of types of segmentation methods have been proposed and sub-divided into 4 types, as shown in Figure: 2.

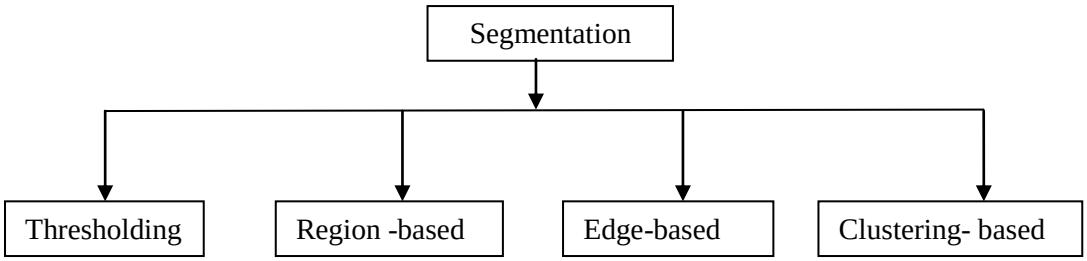

Figure: 2-Types of Segmentation

A. Thresholding

Thresholding is one of the easiest methods in image segmentation, where a grayscale image is transformed into binary image.

B. Region- based Segmentation

In region-based segmentation, the image is separated or clustered into regions based on common properties of an image.

C. Edge-based Segmentation

Edge -based segmentation selects whether the pixels of an image belong to the edge or not. It is one of the simple techniques in image processing, used only for simple images.

D. Clustering- based Segmentation

Clustering-based segmentation is one of the easiest methods, directly applied or extended to the higher dimensional data and mostly used for grey level images.

III. REVIEW

A. Color Space Optimization Segmentation

The color analysis method is used to discriminate the color channels in the lesion. In color channel optimization, color spaces from different color channels are observed. In automatic border detection, color space analysis and clustering based thresholding are used. The method of Color Space Optimization segmentation is shown in Figure: 3.

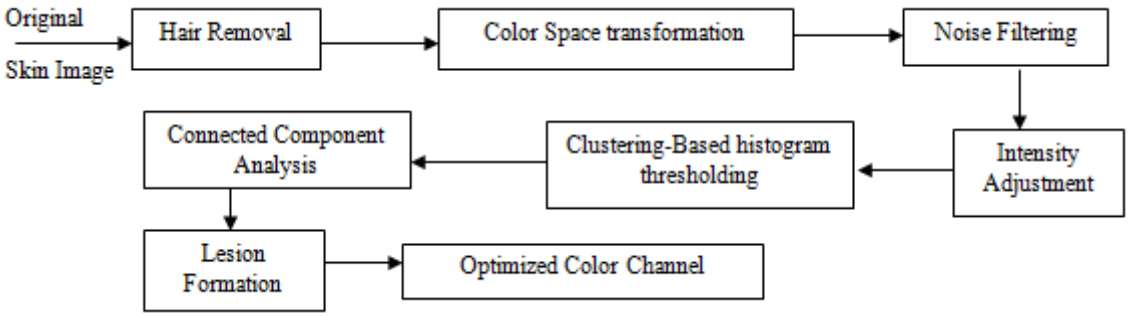

Figure: 3-Color Space Optimization Segmentation

1.) *Hair Removal:* Morphological operation is used to spot out the thick hair were,median filter is used to remove the thin hair.
2.) *Color Space Transformation:* It is used to signify the border automatically, in order to convert the RGB image into different color spaces.
3.) *Noise Filtering:* The skin lines, air bubbles or other types of noise are present in dermoscopic images; they are removed by circular averaging low-pass filter.
4.) *Intensity Adjustment:* The pixel values are altered into new pixel values in order to increase the image contrast and to recognize the accurate threshold value.
5.) *Clustering-based Histogram Thresholding:* The major idea of this method is to conjecture the image into foreground and background (i.e., into two clusters of an image).Optimal threshold level using differentiate analysis is used to detect the lesion accurately.
6.) *Connected Component Analysis:* The main purpose of this method is to eradicate the objects from segmented image. Run-length encoding method is used to connect the objects with the image.
7.) *Lesion Formation:* Morphological filing technique is used to complete the final lesion by filling the holes in the image.

B.) Hybrid Thresholding

Thresholding is one of the techniques used in image segmentation. Hybrid thresholding is one of the segmentation methods used for automatic detection of melanoma [9].The borders that are drawn automatically are less thick when

compared to the manual borders that are drawn by dermatologist. Hybrid thresholding is classified into two types, as shown in Figure: 4

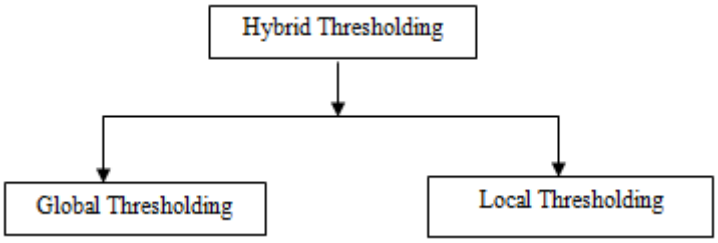

Figure: 4-Types of Hybrid Thresholding

1.) *Global Thresholding:* Global thresholding is to spot out the core –lesion using Otsu's thresholding method. Global thresholding is used to detect the original border based on pixels computations and morphological operations.
2.) *Local Thresholding:* Local clustering is based thresholding on optimal color channels is to illustrate the lesion background boundary and also to extend or contract the lesion.

C. Iterative Thresholding

It is a thresholding- based segmentation, which is used in intensity images. The intensity images measure the light effects or brightness in the image. Double thresholding and elastic curve fitting method are used to identify the lesion boundary. In iterative- based segmentation, the RGB image space is transformed into two intensity images. The RGB image is being transformed into HVC color space, since human color perception is closely related to HVC color space. Subsequently, the HVC image is transformed into intensity image. After re-scaling the image with grey level histogram, the higher and lower values in the lesion are compared. The degree of certainty of pixels signifies the two membership values representing the foreground and background lesion.The degree of certainty refers to any state on the basis of some evidence. The binary images are obtained by calculating the threshold value for two intensity images. Morphological operation is functional to the binary image.To find the final lesion, simple union/operation is performed.The Iterative

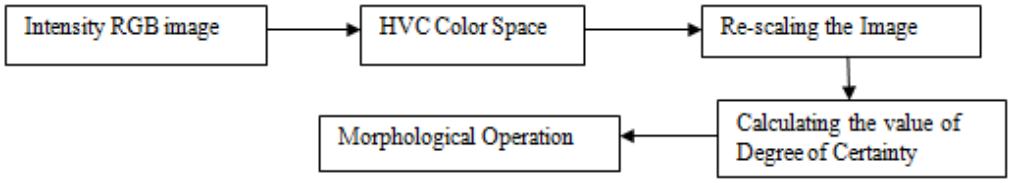

Figure: 5-Iterative Thresholding Segmentation

D. Iterative Segmentation

In iterative segmentation, the lesion border is distinguished by observing the whole image [10].This method is shown in Figure: 6.

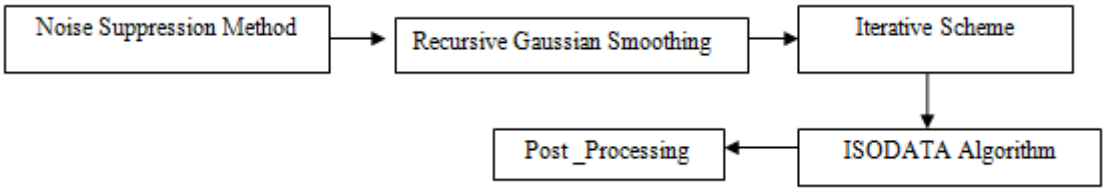

Figure: 6-Iterative Segmentation Method

1.) *Noise Suppression Method:* This technique is used to eliminate the unwanted hair that is present in the skin lesion, since the hairs may look as a streak which is one of the important characteristics in detecting melanoma.
2.) *Recursive Gaussian Smoothing:* This type of smoothing process is used to detract the background from the lesion border and make the lesion clear from the skin. The median values of the regions are divided to detect the lesion.
3.) *Iterative Scheme:* This scheme is used to segment the lesion and the background region from the skin.
4.) *ISODATA Algorithm:* This process is used to validate the optimal threshold from the image by separating the pixels present in the regions. This process is constantly carried out until they get the threshold value.
5.) *Post-processing:* The Post-processing is used to remove the isolated pixels and small objects from the lesion.

E. Co-operative Neural Network Segmentation

It is actuality used to distinguish the lesion border by training the dataset. The lesion edge borders are detected using neural networks. To reduce the noise the low-Pass or averaging is used, which leads to better edge detection [10]. Maximal Thresholds is being used to merge the outputs obtained from the different edge maps. At last, Post-processing is used remove the unwanted objects that appear in the lesion.

F. Watershed Segmentation

Watershed algorithm is commonly used in automatic lesion border segmentation. The watershed algorithm plays a vital role in image segmentation. A neural network classifier and edge object value method (EOV) are used to reduce the detection errors. The neural network classifier is used to develop the first-pass in watershed segmentation, were edge object method is used to eliminate the blobs close to lesion boundary. Noise removal method is applied to reduce the shaped false positive areas [5].

G. Region Growing

Region growing starts with the primary stage of seed point. It clusters the pixels by selecting the criteria in a specific region of seed point and stops the criteria. The lesion pigments on automatic threshold for seed point are detected, by adding the neighboring pixels of related properties. Only one region will be segmented, and the pixels will be automatically selected from skin lesion since the pigment is darker when compared to normal skin. The pixels with the darker regions are selected and the seed is identified. The lesion pigment is selected by calculating the difference between the pixels and average window of neighbors. The region growing segmentation for detecting the lesion is shown in Figure: 7.

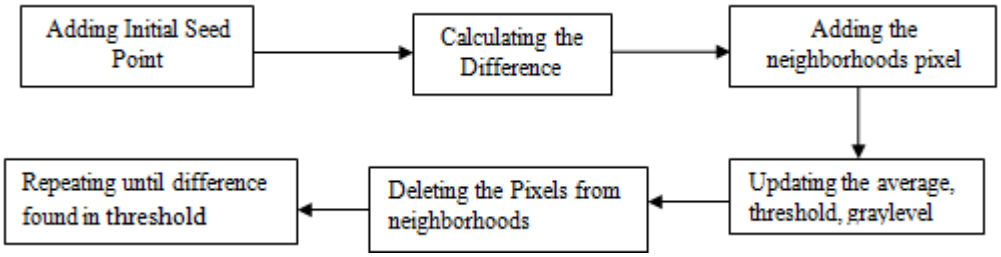

Figure: 7 -Region Growing Segmentation

H. Otsu's Method

Otsu's method is one of the oldest techniques used for automatic segmentation, which divides the background and foreground of the skin lesion. It is one of the leading ways for automatic thresholding [2] which transforms the grayscale image into binary image. Ostu's supports pixel density of an image and iterates the possible values by calculating pixels levels of each side of an image which may fall both on background or foreground. The Ostu's Method is shown in Figure: 8.

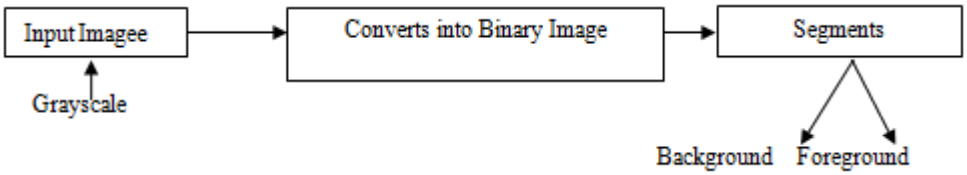

Figure: 8-Ostu's Method

I. K-Means Clustering

Image segmentation techniques have to be categorized into different types. They are pixel-oriented, contour-oriented, region–oriented and color-oriented [3].Color segmentation is one of the key operations in image examination. K-means clustering is one of the modest implementations, which partitions the image into k-clusters by defining the number of centroids.

J. Adaptive Spatial K-means Clustering

Adaptive Spatial K-means Clustering (A_SKM) is another method in clustering, which is used to extract the color features from the skin lesion [7].The k clusters are further processed in A-SKM .It defines the key features of an image such as color smoothness and texture complexity in pixel transmission process.A-SKM works superior than K-means and produces a better result. The advantage of A-SKM is color texture segmentation, where cancer images with low resolution can also produce exact segmentation.

K. Multi-direction Gradient Vector Flow (DGVF)

In gradient vector flow (GVF) snake model, a specific direction is fixed to discover the boundary, where DGVF multidirectional flow is used, so that it traces the objects that are near the skin cancer region. A rough contour and thresholding is done to find the central objects of the image and it is enlarged into 5*5pixles larger than the original image before DGVF is applied to arrive at accurate segmentation. In DGVF, the directional gradient is calculated for each and every pixel of an image with unpredictable direction [8]. We get direction vector for the complete image, were each pixel points the central objects. In GVF, the snake will not track the objects that are close together, so that the boundary that is required cannot be extracted. But in DGVF it will track the object boundary that is desirable, using the direction vector field.

IV. CONCLUSION

The research in melanoma has been emergent very seriously to detect it at an early stage, since it is very severe when related to other types of skin cancer. Different segmentation techniques used in CAD for tracking the boundary of cancer lesion from skin are discussed in this paper. Irregularity in shape it is one of the significant tasks in distinguishing the border accurately.

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