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Deformation Model based Segmentation of Skin Lesions for Medical Image Data

Dr R. Athilingam[1], A. Nagagopinath[2], S.Praveen[3], J. Praveen Raj[4]
[1, 2, 3, 4]*Nadar Saraswathi College of Engineering and Technology*

Abstract: Dermoscopy is medical imaging technique used in diagnosis of skin lesions which needs computer aided diagnosis. An algorithm based on deformable model is proposed to segment and extract the skin lesions in dermoscopic images. Initially, RGB color model is converted into gray scale so that the information details of the images can be used efficiently to differentiate normal skin and skin lesions.

The deviations in the color channels are combined to define the speed and the final criterion of ending the iteration of the deformable model. Our algorithm provides an effective and flexible segmentation. Two set of images from medical databases were used to estimate the performance.

Keywords: Deformable model, lesions, segmentation, Dermoscopy.

I. INTRODUCTION

Segmentation of image involves partitioning of a digital image into multiple related segments. It is used to locate the objects and their respective boundaries like lines and curves in images. In precise, segmentation is the process of assigning a name label to every pixel in image in such a way that pixels with same label consists of certain common characteristics. Each pixel in a region looks similar in some characteristics or computed property like color, intensity, or texture. neighborhood regions are relatively different compared to same characteristics.

A. Level set methods

Level set method (LSM) is a framework for using level sets as a computational tool for numerical analysis of the image surfaces and shapes. The advantage of LSM is that numerical computations constituting curves and surfaces on a fixed Cartesian planar grid can be performed with simple efforts. Also, LSM is easy in order to follow shapes that intend to change topology or reverse of the splitting operations.

B. Medical imaging

Medical imaging is a process of creating visual or pictorial representation of the interior parts of a body for clinical analysis, diagnosis and medical intervention, visual representation of the proper functioning of some organs or muscle tissues. It generates and maintains a database of normal anatomy and physiology to diagnose and identify abnormalities..

C. Melanoma

Melanoma, which is also known as malignant melanoma, is a type of cancer that forms from the pigment-containing cells namely melanocytes. Melanomas generally occur in the skin but in rare cases it occurs in mouth, intestines, or eye. In women they commonly occur on legs, while in men they are common on the back. Sometimes they develop from a mole. It involves with concerning changes like increase in size, color changes, irregular edges, itchiness, or skin breakdown. Melanoma is the most dangerous among different types of skin cancer.

To eliminate this, computer-aided diagnoses (CAD) are needed. Dermoscopy method improves the detection rate of melanomas relatively better compared to perception with the naked-eye which provides accuracy of only 60%. Nevertheless, The diagnostic accuracy largely depends on the experience of dermatologist.

The appearance of skin lesions in dermoscopic images depends on the skin condition. The influence of hair, air bubbles and skin texture may dim out the boundary between skin lesions and the healthy skin surrounding it. Moreover, Dermoscopic images are classified into three types: thresholding, clustering, and deformable models.

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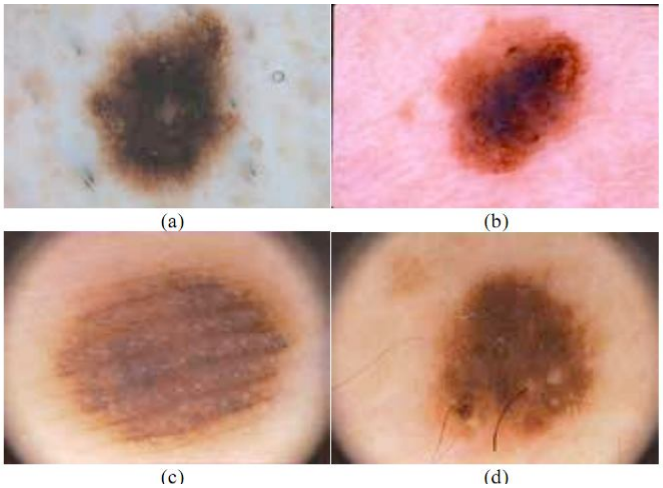

Figure 1. (a) A dermoscopic image with a common nevi; (b)&(c) Two dermoscopic images with melanoma; (d) A dermoscopic image with an atypical nevi.

II. DEFORMABLE MODELS

Deformable models are usually semi-automatic. First, The RGB color space is converted so that the color information available in the images can be effectively used to differentiate between the normal skin and skin lesions. The comparative differences in color channels are summed up together to speed function and the finishing criterion of the model. The main idea behind this technique is to model a curve and segment based on its structure and the speed function of processing is to be defined with which the initial curve can be finalized to the desired boundary.

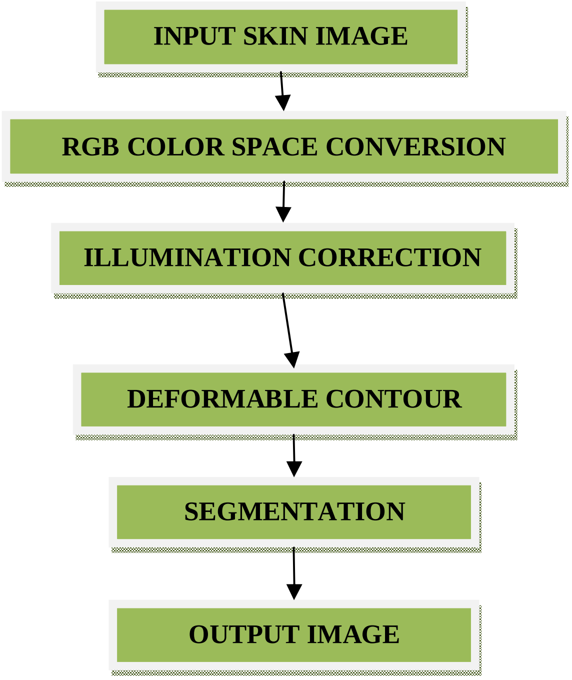

Figure 2. Block Diagram of Proposed system

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D. Color Space

The human visual system measures and records the part of electromagnetic spectrum only through color and it ranges between 300 and 830 nm. The Red – Green - Blue color space is the predominant color space used to store an image color information. But, RGB color representation is not suitable for many segmentation problems. The main reason is that RGB color space has three color channels. The problem with XYZ color system is that in between the individual colors they do not relate to perceived color differences. In order to eliminate this problem and to utilize the color information effectively, two color spaces of the CIE system namely L*a*b* and L*u*v* models have been adopted. The value of *a* in the L*a*b* model involves the position of the color between magenta and green, and the value of *b* stands for the position of the color between yellow and blue.

E. Speed Function

The speed function consists of only the information of normal skin, because the appearance of the skin lesions is very much varied in nature. The locations of the coordinates indicates the primary perceptual difference between the normal skin and skin lesions, Thus the coordinates of pixel values representing the normal skin should be placed near to each other and have relatively wider distance to the coordinates indicating skin lesions. According to this setup, the image pixels are classified into two groups depending on their distances to the centroid of normal skin and skin lesions in color coordinate systems.

F. Stopping Criterion

In the ideal condition, the curve will move inwards based on the speed function, till it arrives at the position where lightness or saturation of the region is different from normal skin. The rapid decrease of the speed value will gradually slows down the inward movement of the curve and it achieves a stable status. This index will reflect the difference of the mean lightness values of internal and external regions of the inward moving curve, its value should increase with the change in curve evolution. Hence, as the curve moves into the region of skin lesions, its value decreases; then, the curve evolution gets stopped.

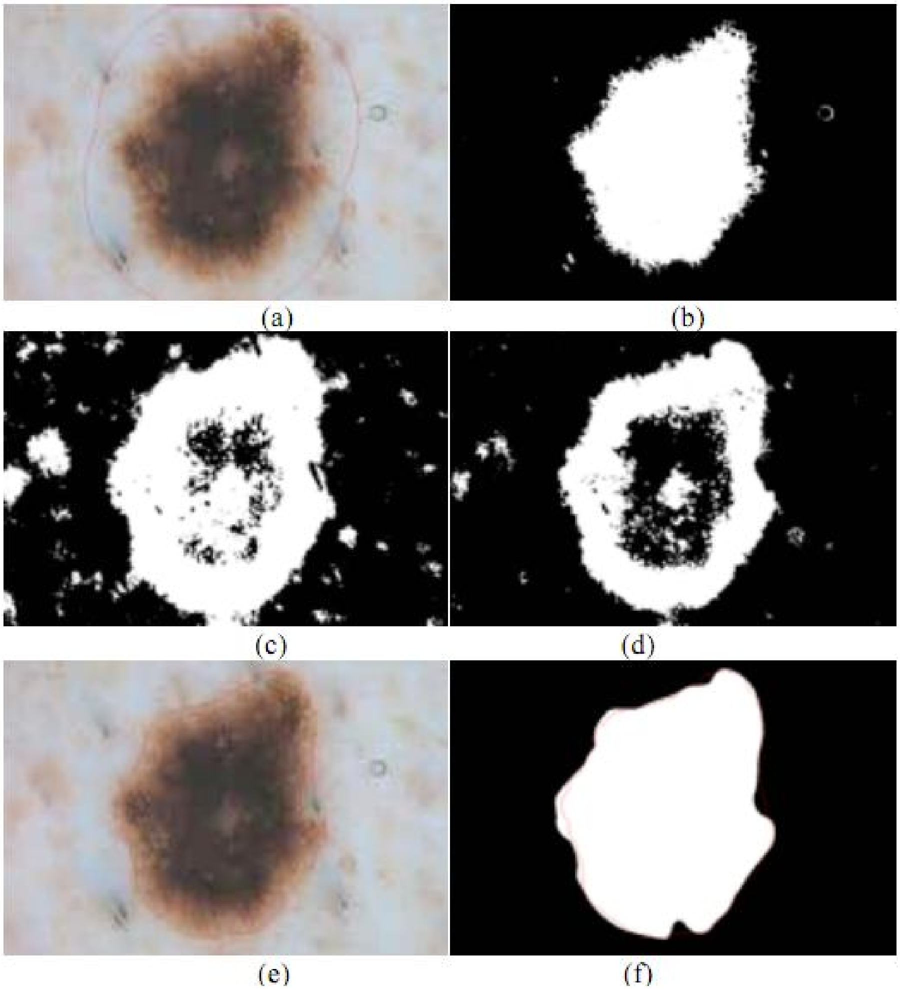

Figure 3. An illustration of the proposed approach with the image

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III. IMPLEMENTATION RESULTS

The dermoscopic images of Skin lesions are acquired and stored offline in stand alone PC installed with MATLAB software with image processing toolkit. The properties of input image are as mentioned in table 1

The input image is shown in figure 4. It is a RGB scale image. The initial level of segmentation is set by red color bounding box (figure 5). The RGB scale is converted into LAB scale as displayed in Fig 6. Figure 7 displays the lightness channel in the CIE color system of the image. The output image with final boundary is displayed in figure 8.

Table 1: Image Properties

Size	230 x 240
Format	Jpg
Resolution	8 bit
Scale	RGB scale
Speed of processing	10 ms

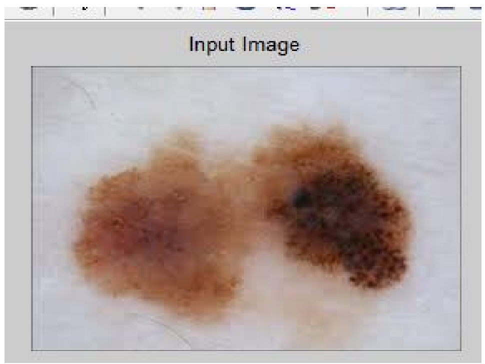

Figure 4.The input image

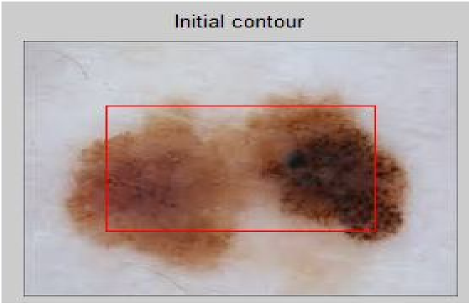

Figure 5.Initial level set box(Red Color)

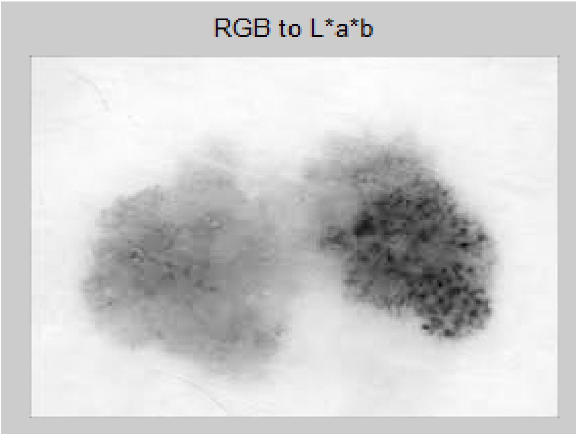

Figure 6.The RGB to Color Space Conversion L*a*b

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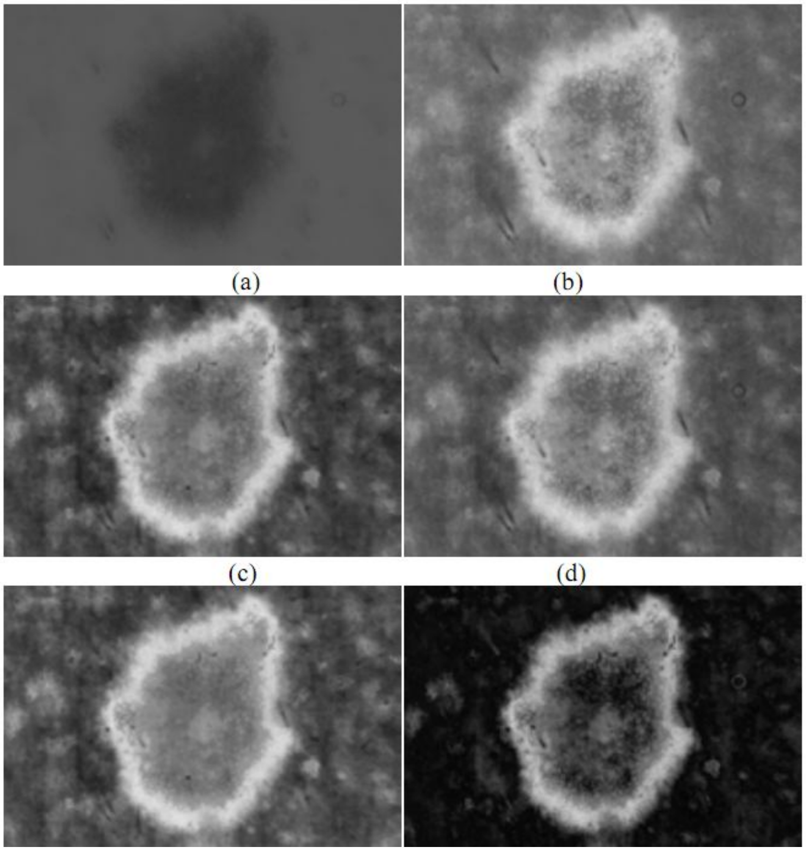

Figure 7. The lightness channel in the CIE color system of the image.

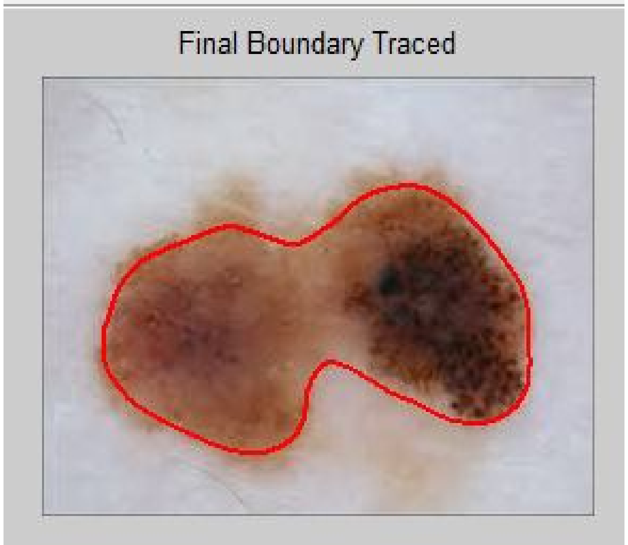

Figure 8 The final output

IV. CONCLUSION

Thus, an easy and efficient approach based on deformable model is implemented to segment skin lesions in dermoscopic images. The proposed algorithm combines the image information available in dermoscopic images, then defines the speed function based on the luminance, brightness, saturation and color information, with which the resultant curve is depicted to stop at the boundary of the skin lesions. The implementation is simple and the segmentation results can easily be adjusted or refined based on the parameter of color sensitivity. The current form of the novel approach is semi-automatic since the initial curves need to be defined manually to avoid negative influence from the complex background.

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