Unsupervised Segmentation and Categorization of Skin Lesions Using Adaptative Thresholds and Stochastic Features

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Abstract

This work presents a novel unsupervised method to segment skin lesions in macroscopic images, grouping the pixels into three disjoint categories, namely 'skin lesion', 'suspicious region' and 'healthy skin'. These skin region categories are obtained by analyzing the agreement of adaptative thresholds applied to the different skin image color channels. In the sequence we use stochastic texture features to refine the suspicious regions. Our preliminary results are promising, and suggest that skin lesions can be segmented successfully with the proposed approach. Also, 'suspicious regions' are identified correctly, where it is uncertain if they belong to skin lesions or to the surrounding healthy skin.

1 Motivation to Segment Skin Lesion Regions into Three Categories

There are different methods in the literature presenting approaches to segment pigmented skin lesions, with their effectiveness already confirmed [1]. However, most skin lesion segmentation methods generate a deterministic skin lesion rim, even when the lesion is affecting some of the surrounding areas with less intensity or has retracted beneath the skin. The proposed method tends to detect accurately 'suspicious regions' and refine their detection using stochastic features.

2 Proposed Skin Lesion Segmentation Approach

The three RGB color channels are used to obtain an initial estimate of the three types of skin regions, and then the initial segmentation is refined using stochastic textures as described in Section 3.

We propose segmenting independently each of the RGB color channels using the Otsu's thresholding method. When analyzing the color information in the RGB color space, the lesion area is assumed to be darker than the background skin. For a given pixel, when all the three thresholded channels agree with the pixel categorization as 'healthy skin' or 'skin lesion', we assign it to the 'healthy skin' or 'skin lesion' categories. However, when there is no unanimous agreement among the three thresholded channels, the pixel is assigned to the 'suspicious region' category. More sophisticated algorithms could be used for the initial segmentation.

3 Skin Lesion Segmentation Refinement

Since pigmented skin lesions have no specific shape, color or texture, we consider the 'healthy skin' and 'skin lesion' as having different stochastic textures. In order to qualify these different stochastic textures within a skin lesion image, we assume the gradient distribution in these different skin regions as represented by asymmetric distributions (e.g. Gamma or Rayleigh), and use stochastic texture features to measure how much they deviate from randomness [2] (e.g. the regions within a skin lesion tend to be more clustered and less random than the surrounding healthy skin, which tends to be less clustered and more random). Also, describing the local gradient magnitudes by an asymmetric distribution facilitates the discrimination between the stochastic textures inside and outside the pigmented 'skin lesions' [3]. In our approach, the discrimination between the 'skin lesion', surrounding 'healthy skin', 'suspicious regions' is performed iteratively using such stochastic features.

4 Preliminary results

The proposed skin lesion segmentation approach was tested on the macroscopic image dataset presented in [4], with the images pre-processed with an algorithm for shading attenuation. Figure 1 shows examples of the preliminary results obtained for the segmentation of atypical nevi and melanomas in three categories of regions using color information.

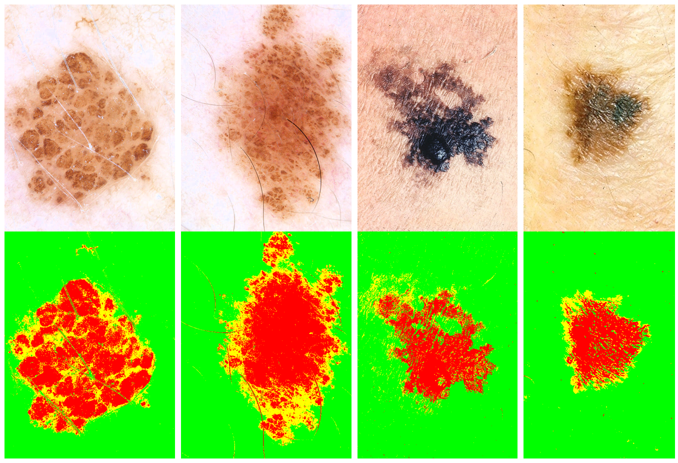

Fig. 1: Illustration of the three segment categories obtained by the proposed method. In green, the 'healthy skin' regions; in yellow the 'suspicious regions'; and in red the 'skin lesion' regions.

5 Conclusions

We proposed a new scheme for segmenting pigmented skin lesions into three categories of skin segments, namely 'skin lesion', 'suspicious region' and 'healthy skin'. As a complementary step, we suggest an approach to refine the segmentation of suspicious areas of the skin image based on different stochastic texture features, and improve the discrimination between 'healthy skin' and 'skin lesion' areas.

Future work will concentrate on improving the estimative of 'suspicious regions', minimizing mistakes in the assignment of areas of the skin image to the 'skin lesion', 'suspicious region' and 'healthy skin' categories of skin regions.

References

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