An interactive Matlab interface for manual dermoscopic image analysis

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Abstract

Dermoscopy is a non-invasive diagnostic technique for the in vivo observation of pigmented skin lesions. In the last few years, several computer-aided diagnosis systems of digital dermoscopic images have been introduced in order to assist the clinical evaluation of dermatologists. These systems must be tested and validated through a ground-truth database of manually segmented images.

Therefore, in this paper, we present a graphical user interface for computer-aided manual segmentation of dermoscopic images. This tool allows building up a reliable ground truth database of manually segmented images. Besides the manual segmentation of the lesion, this tool also allows performing the segmentation of other specific regions of interest, which are essential for the development of newly computer-aided diagnosis systems.

1 Introduction

Dermoscopy (dermatoscopy, skin surface microscopy) is a non-invasive technique for the observation of pigmented skin lesions, allowing a better visualization of the surface and subsurface structures, and the recognition of morphologic structures not visible by the naked eye [1].

The dermoscopic diagnosis of pigmented skin lesions is currently performed by trained dermatologists based on a set on pattern analysis criteria such as the ABCD rule or the seven point check list. Both approaches involve a visual analysis of the skin lesion in which the lesions are evaluated according to several properties, such as the asymmetry, the border irregularity, the color, the diameter, and the presence of atypical vascular pattern or irregular diffuse pigmentation [1, 3].

Currently, there is a great interest in the development of computer-aided diagnosis systems that can assist the clinical evaluation of dermatologists, since the interpretation of dermoscopic images is time consuming and subjective (even for trained dermatologists), and also to reduce the learning-curve of non-expert dermatologists. The standard approach in automatic dermoscopic image analysis has usually three stages: (i) image segmentation, (ii) feature extraction and feature selection, (iii) lesion classification [2].

The validation of these algorithms requires a ground-truth database of manually segmented images. Therefore, this situation calls up for the development of new tools that can support the manual segmentation, making this task easier and faster to the dermatologists.

The tool presented in this paper is a preliminary version. Its final version will allow building up a reliable ground truth database of manually segmented images to be used with multiple purposes. Among these are the assessment of the accuracy of newly developed automatic segmentation methods, as well as the use in medical training. Besides the identification of the lesion borders, this tool also allows marking other specific regions of interest, such as regions with different colors, typical or atypical vascular networks, dots, globules, star burst patterns, etc, whose recognition is crucial for skin lesion classification.

This tool has some advantages with respect to other existing annotation tools, namely better freehand drawing and boundary reshaping functionalities.

2 INTERFACE DESCRIPTION

This application allows performing the manual segmentation of dermoscopic images and storing the result of segmentation. For this, the user has a set of tools to be used sequentially to achieve the desired result. The main functionalities of this interface are:

- Image upload and display
- Manual segmentation
- Boundary reshaping
- Storage of segmented image

The interface was implemented in a MATLAB environment (7.9.0 R2009b) because of its image processing toolbox and graphical facilities.

2.1 Image upload and display

With this application it is possible to open one image or several images at once. For this, it is necessary to select the option “Load images” in the “File” menu, or simply press the button 1 on the toolbar, Figure 1. Then a dialog box appears that enables the user to browse and select the image to be segmented. To open multiple images, simply press CTRL key and select the desired images.

The loaded image is displayed on the left side of the interface. If several images have been loaded, the user can easily change the image that is being displayed through the slider button, Figure 1.

2.2 Manual Segmentation

In order to perform the manual segmentation, this application allows to draw a freehand region of interest on the loaded image. It is important to note that the manual segmentation can be performed using a pen tablet or a mouse. The user can choose between performing the manual segmentation of the lesion or other regions of interest through the radio buttons on the panel “Segmentation”.

To achieve the manual segmentation it is necessary to select in the “Tools” menu the option “Manual Segmentation”, or simply press button...
Adjustments to the initial contour. For this, the user must select the option "Pointwise Boundary Reshaping" in the "Tools" menu, or simply press button 7 on the toolbar, Figure 1. Basically, this method allows the user to draw a line to define the new shape of the contour. The line must intersect the initial contour at least in two points to form a closed contour. This can be used to increase or reduce the size of the initial contour. Note that it is possible to increase and reduce the size of the contour with a single line, Figure 3.

2.4 Storage of segmented image

Finally, this interface also allows storing the result of manual segmentation. The segmentation result is saved as a binary image, where pixels with intensity value of 1 correspond to the segmented object, while pixels with value 0 correspond to the background.

3 CONCLUSIONS

A graphical user interface was presented in this paper, for manual segmentation of dermoscopic images (that can easily be adapted to other medical images). This tool will allow constructing a ground truth database, in a very simple and fast way, to be used in the assessment of the automatic segmentation methods. Moreover, this tool also allows segmenting other specific regions of interest, whose recognition is essential in image classification and pattern recognition.

Besides the manual segmentation, one of the most interesting tool is the boundary reshaping, with which the user can correct the shape of the contour previously done. For this purpose, two distinct methods were implemented, namely “Pointwise boundary reshaping” and “Local boundary reshaping”.

This prototype version was set up based on the requirements and suggestions of dermatologists and is currently under evaluation in clinical environment. Some suggestions, as future work, have already been made by clinicians. For instance: to include by default the possibility of labeling the different regions of interest.

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