

Skin Lesion Analysis Towards Melanoma Detection Using Deep Learning Network

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Abstract. Skin lesion is a severe disease in world-wide extent. Reliable automatic detection of skin tumors is very useful to help increase the accuracy and efficiency of pathologists. International Skin Imaging Collaboration (ISIC) is a challenge focusing on the automatic analysis of skin lesion. In this brief paper, we introduce two deep learning methods to address all the three tasks announced in ISIC 2017, i.e. lesion segmentation (task 1), lesion dermoscopic feature extraction (task 2) and lesion classification (task 3). A fully-convolutional network is proposed to simultaneously address the tasks of lesion segmentation and classification and a straight-forward CNN is proposed for the dermoscopic feature extraction task. Experimental results on the validation set show promising accuracies, i.e. 75.1% for task 1, 84.4% for task 2 and 90.8% for task 3 were achieved.

1 Introduction

Melanoma is the most deadly form of skin cancer and accounts for about 75% of deaths associated with skin cancer [1]. Dermoscopy technique has been developed to improve the diagnostic performance of melanoma. Dermoscopy is a noninvasive skin imaging technique of acquiring a magnified and illuminated image of a region of skin for increased clarity of the spots on the skin [2]. It enhances the visual effect of skin lesion by removing surface reflection of skin. Deep learning approaches using dermoscopy images to automatically detect melanoma have been proposed in recent research [3]. International Skin Imaging Collaboration (ISIC) continuously organized melanoma detection challenges from 2016, which highly promotes the improvements of automatic melanoma detection methods.

In this paper, we proposed two deep learning networks to address the three tasks announced in ISIC 2017 challenges. A multi-scale fully-convolutional residual network is proposed to simultaneously address task 1, i.e. lesion segmentation, and task 3, i.e. lesion classification, and a CNN-based framework is proposed for task 2, i.e. dermoscopic feature extraction.

2 Methods

In this section, we introduce the deep learning methods for different tasks.

2.1 Lesion segmentation and classification (task 1 & 3)

The fully convolutional residual net (FCRN) proposed in our previous work [4] has been extended to simultaneously address the tasks of lesion segmentation and classification. Using the proposed FCRN, we construct a multi-scale deep learning network for skin lesion images.

Data Augmentation. The original ISIC skin lesion dataset contains 2000 images. To enlarge the lesion area for feature detection, we proportionally cropped the center area of each image before augmentation. As the image volumes of different categories widely vary, we accordingly rotated the images belonging to different classes to establish a class-balanced dataset. The dataset augmented with this step is denoted as *DR*. The images in *DR* are randomly flipped along x or y-axis to establish another pair dataset, called *DM*. The two datasets are used to train FCRNs, respectively.

Network Architecture. The flowchart of proposed multi-scale deep learning network is presented in **Fig. 1**. Two FCRNs trained with datasets using different data augmentation methods are involved. The architecture of FCRN is the same as that introduced in [4]. As fully-convolutional network accepts inputs with different sizes, we resize the skin lesion images to two scales, i.e. 300x300 and 500x500. The lesion index calculation unit (LICU) is designed to measure the probabilities for Melanoma, Nevus and Seborrheic keratosis.

The reason for using separate FCRN trained on different datasets, i.e. *DR* and *DM*, is that we found ‘mirror’ operation seems to fool the FCRN during training. In our experiments, single FCRN trained on the combination of *DR* and *DM* was difficult to converge. The segmentation and classification accuracies on validation set verified our findings, i.e. the separate network provides better segmentation and classification performance than that of single FCRN trained using *DR+DM*.

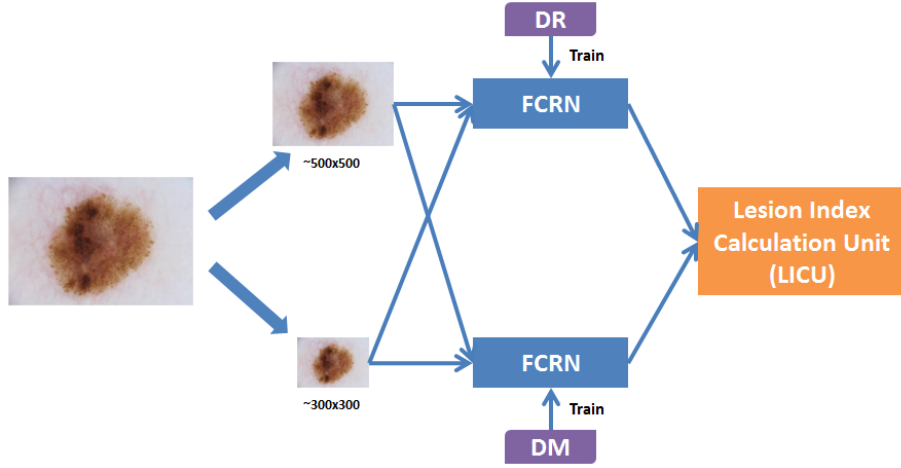


Fig. 1. Flowchart of multi-scale deep learning network.

2.2 Dermoscopic feature extraction (task 2)

We developed a CNN-based approach to address the task 2, i.e. dermoscopic feature extraction. To our best knowledge, this is the first work using deep learning to extract dermoscopic feature from skin lesion images.

Training Data. The ISIC dermoscopic images have four kinds of features, i.e. Network, Negative Network, Streaks and Milia-like Cysts. The dermoscopic images were separated by superpixel masks, which contain the feature information of different dermoscopic images. We used the provided algorithm to extract the content of each superpixel and resize them to a uniform size, i.e. 56x56, for our CNN framework.

Network Architecture. Our CNN framework was trained with the patches extracted from superpixel masks. The flowchart of our CNN framework is presented in **Fig. 2**. While the blue rectangles represent the convolutional layers, the numbers represent kernel size and number of kernels. Both max pooling and average pooling are used and the network was trained with softmax loss.



Fig. 2. Flowchart of CNN-based framework for task 2.

3 Results

We participated all the three tasks announced in ISIC 2017 challenges and achieved promising results, as shown in **Table 1**, on validation sets.

Table 1. Accuracies on the ISIC 2017 validation set

<i>Lesion Segmentation</i> (Task 1)	<i>Dermoscopic Feature Extraction</i> (Task 2)	<i>Lesion Classification</i> (Task 3)
75.1%	84.4%	90.8%

4 Conclusion

In this paper, we briefly introduce the deep learning methods proposed for ISIC 2017 challenge. Our approaches achieve promising results on the validation set and have the potential to be the computer-aid diagnosis system for melanoma detection.

References

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