Skin Lesion Segmentation and Classification using Deep Learning and Handcrafted Features

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Introduction

Skin cancer is one of cancer type that has a significant impact on society in the United States and across the world. Recently, several Computer-Aided Diagnosis (CAD) system papers have been presented. However, there is still an opportunity for further development in the accuracy of its diagnosis. In this research, we propose an algorithm for skin cancer segmentation and classification at a more treatable stage. Our current approach is computationally efficient and combines information from both deep learning and handcrafted features. Our system creates robust hybrid features that have a stronger discrimination ability than single method features. These features are used as inputs to a decision-making model that is based on a Support Vector Machine (SVM) classifier. Extensive experiments are conducted on the ISIC 2018 challenge dataset without using any external dataset to demonstrate the efficacy of the proposed model. Our model is currently ranked #9 for lesion segmentation and #12 for lesion diagnosis on the live leaderboards (https://challenge2018.isic-archive.com/live-leaderboards/).

Problem Statement

Skin cancer is one of the most prevalent forms of cancer in the United States. Melanoma is a lethal form of skin cancer, and it is among the most common cancer types in the United States. However, survival rates are high if detected and diagnosed early. Traditional machine learning and deep learning can play a significant role in Medical Image Diagnosis

Objectives

The objective of this research is to support the development of algorithms for automated diagnosis of melanoma, the most fatal skin cancer, and other six possible disease categories such as Melanocytic nevus (NV), Basal cell carcinoma (BCC), Actinic keratosis intraepithelial carcinoma (AKIEC), Benign keratosis (BKL), Dermatofibroma (DF), and Vascular lesion (VASC). Our goal is to develop the automated system for segmentation and diagnosis of skin lesions and to reduce melanoma-related deaths. Moreover, the importance of this study is to reduce unnecessary biopsies by improving the accuracy and efficiency of melanoma early detection.

Segmentaion and Classification Models

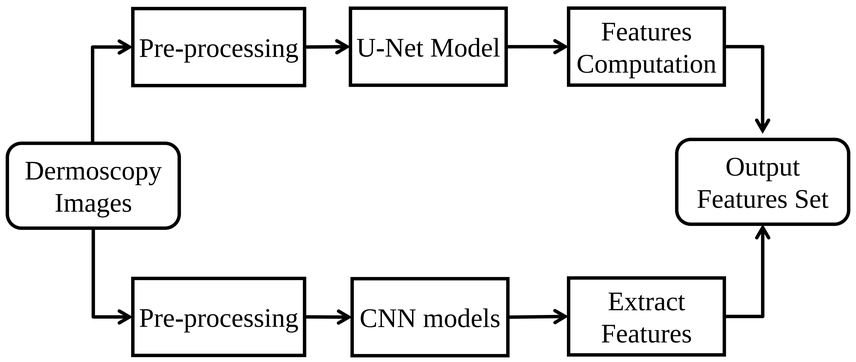

Figure 1: The block diagram of our current system for features extraction

Step 1: Preprocessing step is performed using color constancy, the Shades of Gray method, by Finlayson [1]. We apply this technique on all of the images during training and testing as a preprocessing step. We want to make all images appear identical to colors under a canonical light.

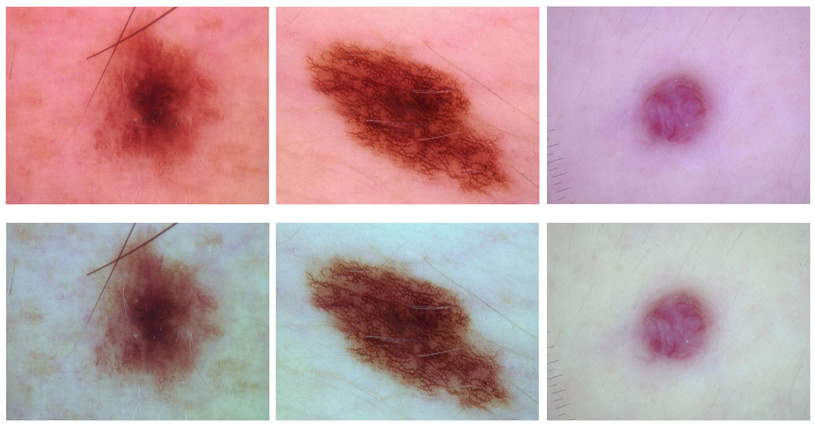

Figure 2: Results obtained using Color Constancy

Step 2: We propose Convolutional Neural Networks (CNN) based ensemble methods for improving the existing performance of lesion segmentation. The proposed ensemble technique includes VGG19 and U-Net.

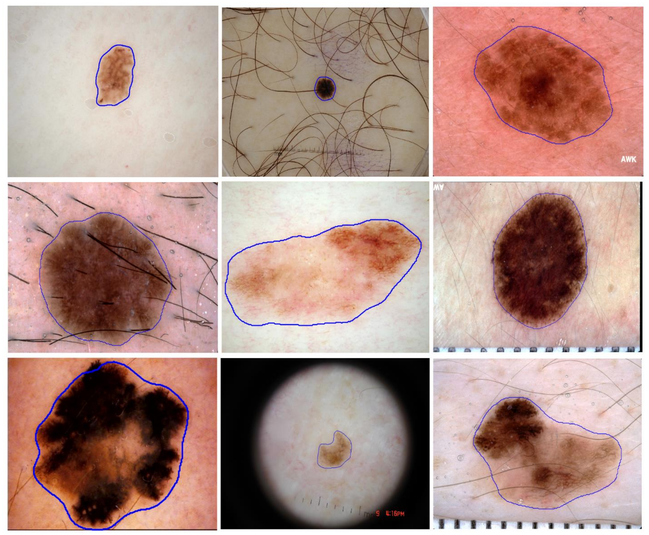

Figure 3: Shows skin lesion segmentation results on the ISIC 2018 test datasets. The blue contours represent the segmentation output

Step 3: Train a multiclass Support Vector Machine (SVM) classifier using robust hybrid features.

Experimental Results

Diagnosis Category	AUC	Accuracy
Melanoma	0.775	0.913
Melanocytic nevus	0.885	0.878
Basal cell	0.907	0.958
Actinic keratosis	0.876	0.956
Benign keratosis	0.837	0.922
Dermatofibroma	0.903	0.982
Vascular lesion	0.883	0.989
Mean Value	**0.867**	**0.943**

References

[1] 16.Finlayson, G. D., & Trezzi, E. (2004, January). Shades of gray and colour constancy. In Color and Imaging Conference (Vol. 2004, No. 1, pp. 37-41). Society for Imaging Science and Technology.

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