COM 4801 Final Year Project

Project Plan

Deep learning for diagnosis of skin cancer

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1. Introduction

1.1 Background

Skin cancer is the most common form of cancer, globally accounting for at least 40% of cancer cases[9]. The key to the treatment is early detection. Data from the American Cancer Society showed that the estimated 5-year survival rate of diagnosed patients can rise 82% if they are detected in the earliest stages[10]. Along with the development of deep learning algorithms in recent years, an increasing amount of researchers have focused their research on the lesion images classification using Deep Neural Network(DNNs)[9]. Although current deep learning models are still at the beginning stage, most have a performance with over 60% accuracy and specificity[9], the highest one even reached 95% sensitivity. More and more clinicians have been taking AI to assist in the diagnosis of skin cancer.

However, there are still many challenges in this field. Goyal’s work(2019) listed 12 upcoming challenges. For instance, most models have poor interpretability, which will lead to confusion for clinical experts. After all, deep learning itself is a “black box” process. Moreover, the performance of neural network frameworks relies on the quality of datasets to a large extent. Nearly 15 datasets of skin lesion images are available publicly nowadays. But these sets have problems such as imbalance in benign skin lesions and malignant lesions, inconsistency in color, and shooting angles[9], lack of annotated data[8]. All these problems block the further development of this area.

1.2 Motivation

Early detection is of great significance in the treatment of skin cancer. While the data set is of vital importance to the deep learning models. Current skin cancer detection AIs use different neural network frameworks. If we can find a higher accuracy model, or use some techniques to conduct data augmentation, the performance of model prediction will be promoted.

1.3 Project Objective

According to our literature study[9], problems regarding data sets’ variety and reliability are the main challenges and opportunities of this field of study. As it seems impossible for us students to collect data and label them, we will focus on studying data preprocessing and augmentation technologies.
Among all these deep learning mode papers, “Skin lesion synthesis with generative adversarial networks” from Bissoto team(2019) aroused our interest most. And this project will mainly aim to reproduce the neural network model in that paper and conduct accuracy tests using different data sets. Moreover, we will explore other methods to achieve data preprocessing, data normalization, or data augmentation including Generative Adversarial Network (GAN)[8].

2. Methodology

In this section, the data sets we plan to use, the implementation methodology of our networks, and the possible data augmentation methods will be introduced. We plan to use Pytorch as our deep learning framework. As for evaluation metrics, we will use the Specificity Score and Sensitivity Score to evaluate our model performance.
2.1 Data Sets

As the project objection focuses on data augmentation and the model’s adaptability to different data sets. Some data sets other than the following data sets might be used later.

2.1.1 ISIC Archive

Clinical and dermoscopic skin lesion data sets including HAM10000[1] and BCN20000[2].

2.1.2 Derm7pt

Dermoscopic and clinical images based on a 7-point check-list[3]: a widely used clinical methodology of a skin cancer diagnosis.

2.2 Model

The model chose to experiment in this project is the winning model of the 2019 ISIC Challenge, which is based on multi-resolution EfficientNets.

2.2.1 Model Architecture

As Figure 2 shows, the model consists of two parts: the CNN Model part is an EfficientNet block which takes dermoscopy photos as input. The fully connected layers below take patient meta data as input. The feature selected by the two parts are concatenated to generate the final classification results[4].

Fig. 2. Approach for combining the CNN model with meta data. (BN refers to Batch normalization)
In this project, we plan to thoroughly study the implementation of this model and reproduce it to run later experiments.

2.2.2 Reasons for Model Selection

The model is selected because of its three superior properties: firstly, EfficientNet, the model based on, is a state-of-art neural network architecture for image classification[5]; Secondly, it utilizes auto-augmentation to select augmentation policy, serving as a basis for further discussion about data augmentation; Thirdly, it ensembles EfficientNets which take pictures of different resolution, allowing a large variety of input data[4].

2.3 Data Augmentation

In this project, we plan to investigate the importance and influence of data augmentation on skin cancer prediction tasks. Here are some possible directions for research.

2.3.1 AutoAugment

AutoAugment is an automatic way to search for optimized data augmentation policies. The policies contain operations like changing brightness, contrast, random flipping, random rotation, and random scaling on the training images[6]. We plan to test the influence of AutoAugment on the prediction performance.

2.3.2 Data Augmentation Techniques

Besides searching automatically mentioned above, we also plan to investigate the effect of certain augmentation scenarios including saturation, contrast, flips, and crops, etc.[7]

2.4 GAN for data Augmentation

GAN, referring to Generative Adversarial Network, is an algorithm generating verisimilitude fake images (illustrated in Figure 3) to enhance the limited data set. We also plan to reproduce a GAN to examine the improvement that GAN can make on our established model [8].
Fig. 3. Images generated by GAN in the paper [8].

3. Timetable

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestones</th>
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<tbody>
<tr>
<td>4 Oct 2020</td>
<td>Deliverables of phase 1 (Inception)</td>
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<tr>
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<td>• Detailed project plan</td>
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<td>• Project web page</td>
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<tr>
<td>25 Oct 2020</td>
<td>• Conduct Investigation in Relative Fields</td>
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<tr>
<td>20 Dec 2020</td>
<td>• Reproduce the Neural Network Model and Conduct Tests</td>
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<tr>
<td>11-15 Jan 2021</td>
<td>• First Presentation</td>
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<tr>
<td>24 Jan 2021</td>
<td>Deliverables of Phase 2 (Elaboration)</td>
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<td>• Preliminary implementation</td>
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<td>• Detailed interim report</td>
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<td>28 Feb 2021</td>
<td>• Finish Data Augmentation Part</td>
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<td>1 Mar 2021</td>
<td>• Start implementing Generative Adversarial Network</td>
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<td>18 Apr 2021</td>
<td>Deliverables of Phase 3 (Construction)</td>
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<td>• Finalized tested implementation</td>
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<td>• Final report</td>
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<td>19-23 Apr 2021</td>
<td>• Final presentation</td>
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<td>4 May 2021</td>
<td>• Project exhibition</td>
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Table 1: Timetable of this Project
References:


