COVID 19:
Severity of pneumonia analysis using Chest X rays

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Abstract

Purpose: To identify pneumonia location and determine the severity of pneumonia using deep learning network on X-ray images of lungs

Methods: Data from RSNA Pneumonia detection challenge from Kaggle is used for train and test analysis. Identifying images and calculating severity percentage of lung opacity in pneumonia present images by drawing bounding box

Results: With 4668 X-ray images trained and tested on 1500 X-ray images, initial model has shown a mean average precision (mAP) of 0.90 on train set and 0.89 on test set

Introduction

Coronavirus also known as COVID 19 is a highly contagious disease caused due to severe acute respiratory syndrome corona virus 2 (SARS-CoV-2).

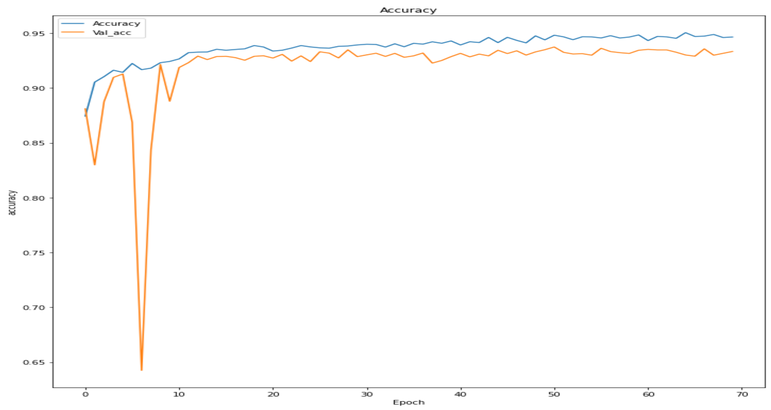
Patients infected with virus show regular symptoms of cold, fever, cough, respiratory issues like shortness of breath, difficulty in breathing. As severity of infection increases patients can have pneumonia, severe acute respiratory syndrome, dysfunction of kidneys, etc. leading to death.
Radiology is playing critical role to identify, if a patient can go home to wait for test results (or) get admitted for further observation. One of the roadblocks using X-ray is the availability of the radiology expert to interpret the image.

With Deep learning techniques like Mask RCNN, X-ray images can be more accurately and efficiently diagnose the disease by understanding the severity and type with pattern. In the current model, data set used with X-ray images are (a) Pneumonia, (b) No Pneumonia & not normal, and (c) normal types.

Methods and Materials

Dataset used for building the model is from a Kaggle competition – RSNA Pneumonia Detection Challenge. The US National Institutes of Health, The Society of Thoracic Radiology, and MD.ai were in collaboration to build a dataset that is rich in quality for the real life challenge.

Initial images received from the dataset are in the DICOM format (*.dcm). They contain a combination of header metadata as well as underlying raw image arrays for pixel data. Most of the standard headers containing patient identifiable information have been removed. Understanding the data structure, imaging file format and label types, primary objective is to detect the bounding boxes consisting of binary classification i.e. presence (or) absence of Pneumonia.



Results

Classification:
VGG16 accuracy: 93.3%

Severity Detection by segmentation:
mAP : 0.90 on train set
0.89 on test set

Discussion

This can guide doctors, radiologist to perform more accurate diagnosis on patients to save time and improve on consistency of treatment. In this study, developing a model on X-ray images to understand the severity of the pneumonia with bounded box around the diseased area was done.

Making investigations more explainable in an attempt to gain deeper insights. One could use these bounding boxes to train a Mask RCNN to not only classify images with pneumonia, but also identify where in the image pneumonia is located.

Conclusions

The intention is to leverage on existing studies and develop a better performing and highly accurate deep learning model to calculate severity percentage in a pneumonia present x-ray image of the lungs. The purpose is to track the target accurately and show the percentage of the severity.

Figure 1. Ground Truth Image.

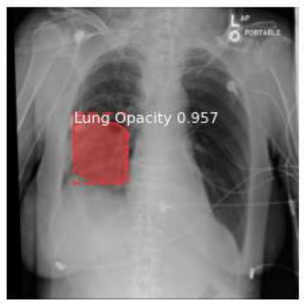


Figure 2. Predicted Image.

Table 1. Confusion Matrix for Test and Train

Predicted	Original	#Class ID's
0	0	10
	1	1
1	0	595
	1	894

Predicted	Original	Class ID's
0	0	15
	1	3
1	0	1860
	1	2790

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