COVID-19 detection in chest X-ray images using Convolutional neural networks

A project report submitted in partial fulfillment of the requirements for mini project in Neural Computing Architecture subject

by

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ABSTRACT

The outbreak of Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome (SARS); in response to the rapidly increasing number of cases of the emerging disease, this Analysis attempts to provide a comprehensive review of the Covid-19 Virus. We hope that this Analysis helps in understanding and taking some precautions of the disease as the Analysis provides the significant symptoms of COVID-19 and what age groups are mostly getting affected and Analysis on the number of cases through a period for each state. So, in this particular situation, one primary thing that needs to be done is manual testing, so that the actual situation can be understood and appropriate decisions can be taken. But the drawbacks of manual testing include the availability of testing kits, which are costly and inefficient blood tests; a blood test takes hours to generate the result.

So, the idea is to overcome these limitations using the Deep Learning technique for efficient treatment. The faster we produce the results, the fewer cases in the city, that's why we can use CNN to get our job done.

Keywords: Coronavirus, pneumonia, outbreak, SARS-CoV-2, COVID-19.

1 Introduction

On December 31, 2019, a great number of cases of pneumonia of unknown cause, in the city of Wuhan in China, was reported to the World Health Organisation. In January 2020, an anonymous new virus was identified and named the 2019 novel coronavirus. Coronavirus a.k.a COVID-19 is a family of viruses that affect the respiratory system of a person. Respiratory diseases can be the common cold to more severe diseases as SARS and MERS. Corona virus got its name because of the way they look under a microscope.The virus consists of a genetic material surrounded by an envelope with protein spikes, which appears like a crown. The word Corona means "crown" in Latin.
Humans cannot determine a COVID-19 positive patient without a label on them. Computer vision and deep learning prove to beneficial by solving this problem by adopting an end-to-end learning architecture, utilizing chest x-rays.

Convolutional Neural Network is a special Neural Network used for image recognition. CNN are much better than ANN because for learning a certain pattern in a picture, a convolutional network can recognize it anywhere, CNN takes advantage of local spatial coherence of images. As humans we can't differentiate an image without having a label on them but a CNN can distinguish it. We can distinguish the x-ray image using a deep-learning method called Convolutional Neural-Networks, which stores the features of the different label images.

2 Dataset

COVID-19 chest x-ray image dataset

- Public open dataset of chest X-ray and CT images of patients which are positive or suspected of COVID-19 or other viral and bacterial pneumonias.
- Total of 930 images of all diseases scans.
- Open database available on GitHub.
- Last updated on Mar 2021.

Normal person chest x-ray image dataset

- There are 5,863 X-Ray images (JPEG) and 2 categories (Pneumonia/Normal). 1341 images are of Normal category.
- Chest X-ray images (anterior-posterior) were selected from retrospective cohorts of pediatric patients of one to five years old from Guangzhou Women

Figure 1: COVID-19 patient chest x-ray sample

and Children's Medical Center, Guangzhou. All chest X-ray imaging was performed as part of patients' routine clinical care.

- For the analysis of chest x-ray images, all chest radiographs were initially screened for quality control by removing all low quality or unreadable scans. The diagnoses for the images were then graded by two expert physicians before being cleared for training the AI system. In order to account for any grading errors, the evaluation set was also checked by a third expert.
- Available on Kaggle, since 2017.

Figure 2: Normal (Pneumonia) patient chest x-ray sample

3 Pre-processing

- Converting 224x224 RGB image to BGR image, because OpenCV library uses BGR image format.
- Scaling the pixel values are between 0 and 255 we divide each pixel value by 255, so that we scale them down to 0 and 1.

- Data augmentation: Horizontal flip, Slight zoom, Slight shear.
- Resize to 224x224x3 RGB to BGR format.
- Splitting of dataset into train, validation, test in the ratio of 0.8 : 0.1 : 0.1 respectively

4 Architecture

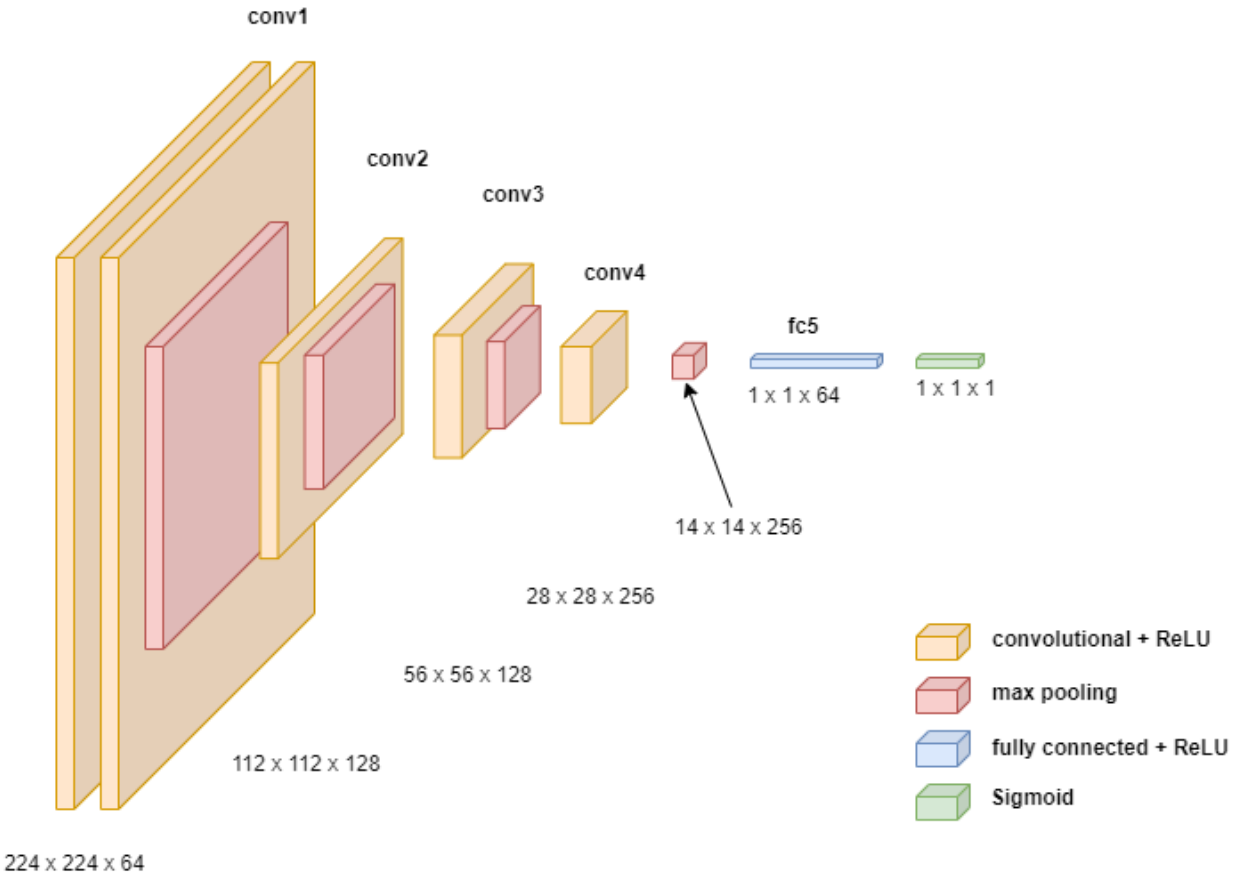

Figure 3: Model architecture

5 Results

Model	Kernel size	Pool size	Padding	Training accuracy	Validation accuracy
Model1	2	2	same	0.984	0.922
Model2	2	3	same	0.961	0.943
Model3	2	3	valid	0.977	0.96
Model4	3	2	same	0.974	0.969
Model5	3	2	valid	0.941	0.906
Model6	3	3	same	0.984	0.93
Model7	5	2	valid	0.89	0.87
Model8	6	2	same	0.948	0.90
Model9	6	2	valid	0.863	0.844
Model10	7	2	same	0.95	0.92

Figure 4: Comparative analysis by varying different parameters