Diagnosing COVID-19 Pneumonia using Deep Learning

Dr. Sanjay Sharma[1], Jayesh Sharma[2]

[1]Associate Professor, Dept. of Computer Engineering, NHITM Maharashtra, Thane
[2]Student, Dept. of Computer Engineering, NHITM Maharashtra, Thane

---***---

Abstract - *The coronavirus is rapidly spreading across the world. As of 14th July 2020 the coronavirus disease has infected more than 13.2 million and has resulted in the deaths of more than 575,000. Diagnosis of this disease takes time and the testing equipment is expensive, so there is a need to develop an automatic diagnosis system that reduces the time of testing so that appropriate medical attention and treatment is given to the patient as soon as possible. Deep Learning techniques can contribute a lot in the development of such a system. For the classification of whether the person has COVID – 19 Pneumonia we have used Convolutional Neural Networks (CNN) it is a supervised deep learning algorithm and the dataset consists of X-Ray images of suspected patients. . With respect to the results of accuracy the efficiency of the algorithm is measured. These techniques are coded in python and executed on Spyder. Our experiments have shown that the accuracy of our model with the use of CNN is about 97% .*

Key Words: COVID-19, Pneumonia, CNN, X-Ray, Max-Pooling, Convolution, Flattening

1. INTRODUCTION

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people who get COVID-19 have mild or moderate symptoms like coughing, fever, shortness of breath. But some who catch the new coronavirus get severe pneumonia in both lungs. COVID-19 pneumonia is a serious illness that can be deadly. Pneumonia is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty breathing.
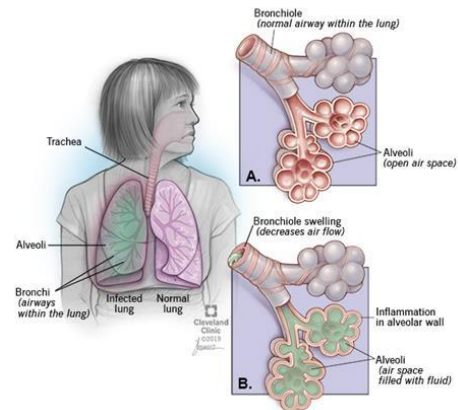

Fig-1: In a person with pneumonia, the airways (bronchi) swell and the air spaces (alveoli) fill with mucus and other fluids.

1.1 What is novel coronavirus-infected pneumonia?

The illness tied to the new coronavirus was originally called novel coronavirus-infected pneumonia (NCIP). The World Health Organization renamed it COVID-19, which is short for coronavirus disease 2019.

COVID-19 Pneumonia Symptoms:

If your COVID-19 infection starts to cause pneumonia, you may notice things like:

- Rapid heartbeat
- Shortness of breath or breathlessness.
- Rapid breathing
- Dizziness
- Heavy sweating

1.2 How many people with COVID-19 will get pneumonia?

About 15% of COVID-19 cases are severe. That means they may need to be treated with oxygen in a hospital. About 5% of people have critical infections and need a ventilator. People who get pneumonia may also have a condition called acute respiratory distress syndrome

(ARDS). It's a disease that comes on quickly and causes breathing problems.

The new coronavirus causes severe inflammation in your lungs. It damages the cells and tissue that line the air sacs in your lungs. These sacs are where the oxygen you breathe is processed and delivered to your blood. The damage causes tissue to break off and clog your lungs. The walls of the sacs can thicken, making it very hard for you to breathe.

2. PROPOSED WORK

The overall system of diagnosing COVID-19 Pneumonia can be divided into two parts:
- ➢ Collection of Images to form the dataset
- ➢ Training and testing of data to form the model

2.1 Collection of Images to form the dataset

Our dataset consists of 188 X-Ray images out of which we have used 148 for training purposes and 40 for testing purposes. In the training set 74 images are of patients who have COVID-19 pneumonia and 74 images are of patients who don't suffer from COVID-19 pneumonia. In the test set 20 images are of patients who suffer from COVID-19 pneumonia and 20 images are of patients who don't suffer from it.

2.2 Training and testing of data to form the model

For training our model we have used the CNN algorithm. In deep learning, a convolutional neural network most commonly applied to analysing visual imagery. During training each X-Ray image is passed through the Convolution and Max-pooling layers after which image data is flattened and fed to the layers of the fully – connected neural network. The neural network then predicts the output class which is then compared to the actual output. The comparison is then used to adjust the weights of the neural network.
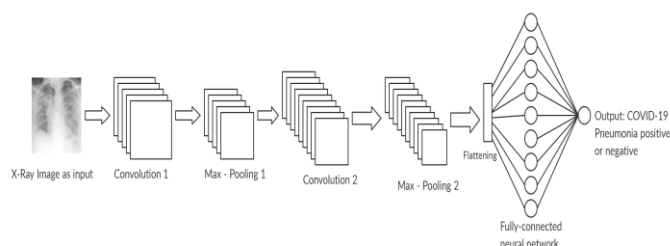

Fig-2: CNN

3. RESULTS

Table-1: Metrics observed for the model

Metric	Value
loss	0.1376
accuracy	0.9352
val_loss	0.0227
val_accuracy	0.9773

'loss' is the value of cost function for training data and 'val_loss' is the cost function for cross-validation data. Similarly the 'accuracy' is the accuracy of training data and 'val_accuracy' is the accuracy of test data. Our model is going is to be used in a field where high accuracy is needed, this model fulfils that requirement.

Examples,

Fig-3: COVID-19 Positive

```
In [4]: import numpy as np
   ...: from keras.preprocessing import image
   ...:
   ...: test_image = image.load_img('positive.jpeg',
target_size = (64,64))
   ...: test_image = image.img_to_array(test_image)
   ...: test_image = np.expand_dims(test_image, axis = 0)
   ...: result = classifier.predict(test_image)
   ...:
   ...: training_set.class_indices
   ...:
   ...: if result[0][0] == 1:
   ...:     prediction = 'COVID-19 Pneumonia Positive'
   ...: else:
   ...:     prediction = 'COVID-19 Pneumonia Negative'

In [5]: prediction
Out[5]: 'COVID-19 Pneumonia Positive'
```

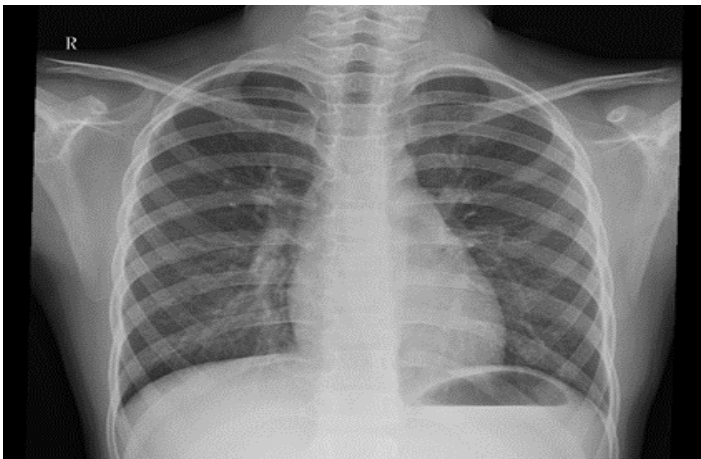**Fig-4:** COVID-19 Pneumonia positive predicted by the model

Fig-5: COVID-19 Negative

```
In [8]: test_image = image.load_img('negative.jpeg',
target_size = (64,64))
   ...: test_image = image.img_to_array(test_image)
   ...: test_image = np.expand_dims(test_image, axis = 0)
   ...: result = classifier.predict(test_image)
   ...:
   ...: training_set.class_indices
   ...:
   ...: if result[0][0] == 1:
   ...:     prediction = 'COVID-19 Pneumonia Positive'
   ...: else:
   ...:     prediction = 'COVID-19 Pneumonia Negative'

In [9]: prediction
Out[9]: 'COVID-19 Pneumonia Negative'
```

Fig-6: COVID-19 Pneumonia negative predicted by
the model

4. CONCLUSION

This paper has discussed how we can diagnose COVID-19 Pneumonia using a deep learning model. The model is a classification model and uses the CNN algorithm. It expects chest X-ray of the patient as input and outputs positive when the patient has COVID-19 Pneumonia, else the test result is negative. The system is tested over a wide range of images yielding a high accuracy rate.

REFERENCES

[1]   Coronavirus disease (COVID-19) pandemic. https://www.who.int/emergencies/diseases/novel-coronavirus-2019

[2]   Pneumonia (2019). https://www.who.int/newsroom/fact-sheets/detail/pneumonia

[3]   Pneumonia. National Heart, Lung, and Blood Institute. http://www.nhlbi.nih.gov/health/health-topics/topics/pnu.

[4]   O'Shea, Keiron & Nash, Ryan. (2015). An Introduction to Convolutional Neural Networks. ArXiv e-prints.

[5]   Rubin GD, Ryerson CJ, Haramati LB et al (2020) The role of chest imaging in patient management during the COVID-19 pandemic: a multinational consensus statement from the Fleischner Society. Radiology. https://doi.org/10.1148/radiol.2020201365