# Covid 19 And General Pneumonia detection from X Ray image using Deep Learning Approach

Khosnur Alam[1], Rima Akter[2]

Daffodil International University , Dhaka, Bangladesh.

khosnur15-1123@diu.edu.bd, nishirima.official@gmail.com

**Abstract.** December 31, 2019 a new virus starts spreading in Uhan of China . Nowadays April 2020 the world has seen the worst Pandemic of the century. World health organization tells everybody to test and test but the test is very rare and costly for 3rd world countries. A cheap and easier testing method is now badly required for countries like Bangladesh. So we want to develop a computer base detection system that can identify Covid-19 patients in a fast and easy way. The chest X-ray image of Covid-19 patients is similar to pneumonia patients. This proposed system can separate Covid-19 X-ray image from pneumonia. The main objective of this research is to develop a system that can detect covid-19 and pneumonia from X-ray images using a deep learning approach.

**Keywords:** Covid-19 Chest X-ray, Covid-19 detection .

## 1.0 INTRODUCTION

The Covid-19 pandemic is an ongoing pandemic of coronavirus disease 2019 caused by Sars-CoV-2. First identified in Wuhan, China, in December 2019, it was declared as pandemic by the World Health Organization on 11 March,2020.[5]

The virus is primarily spread between people during close contact often via small droplets produced by coughing, sneezing, and talking. The droplets, although produced when breathing out, usually fall to the ground or onto surfaces rather than remaining in the air over long distances. One can also get infected by touching a contaminated surface and then touching their faces.

This SARS-CoV-2 virus has infected millions of people and costs a lot of life. Everyday life has hampered like nothing before. People are forced to stay at home. Millions of people are suffering severely from this virus.

To stop the spread of this virus, most countries have taken strict lockdown measures. And another step to stop this virus is identifying infected people as fast as possible. For this purpose we need to test a lot of people. But Covid-19 testing is quite expensive. So a cheaper solution is much appreciable in this case, especially for a 3rd world country like Bangladesh.

Covid-19 can be detected from chest X-ray images. But the problem is it has similarity to pneumonia. So, it is necessary to separate Covid-19 patients from pneumonia patients. So , in this study we are proposing a deep learning base solution to check whether an X-ray image is actually a Covid-19 positive or not.

## 2.0 RELATED WORKS

There are very few studies on literature due to the emergence of COVID-19 virus disease. Some of these are as follows:.

Marcelo Fiszman, MD, Wendy W. Chapman, Dominik Aronsky, MD, R. Scott Evans, PhD, Peter J. Haug, MD have worked on automated Automatic Detection of Acute Bacterial Pneumonia from Chest X-ray Reports and they have used their model in 2000 [6]

Pranav Rajpurkar, Jeremy Irvin, Kaylie Zhu, Brandon Yang, Hershel Mehta, Tony Duan, Daisy Ding, Aarti Bagul, Curtis Langlotz, Katie Shpanskaya, Matthew P. Lungren, Andrew Y. Ng they develop an algorithm that can detect pneumonia from chest X-rays at a level exceeding practicing radiologists. Our algorithm, CheXNet, is a 121-layer convolutional neural network trained on ChestX-ray 14.[7]

Ali Narin1, Ceren Kaya, Ziynet Pamuk have worked on Automatic Detection of Coronavirus Disease (COVID-19) Using X-ray Images and Deep Convolutional Neural Networks they have used existing models to train .[8]

Dimpy Varshni, Kartik Thakral , Lucky Agarwal, Rahul Nijhawan, Ankush demonstrate that pre trained CNN models employed along with supervised classifier algorithms can be very beneficial in analyzing chest X-ray images, specifically to detect Pneumonia.[9]

Okeke Stephen , Mangal Sain , Uchenna Joseph Maduh and Do-Un Jeong constructed a convolutional neural network model from scratch to extract features from a given chest X-ray image and classify it to determine if a person is infected with pneumonia.[10]

Daniel S. Kermany, Michael Goldbaum, Wenjia Cai, Carolina C.S. Valentim, Huiying Liang, Sally L. Baxter developed an artificial intelligence system using transfer learning techniques method to accurately distinguished bacterial and viral pneumonia on chest X-rays.[11]

## 3.0 METHODOLOGY

**3.1 Dataset:** In this study, chest X-ray images of 50 COVID-19 patients have been obtained from the open source GitHub repository[9]. The dataset consists of 340 chest X-ray images. The images are collected from different sources such as different open publications and individuals. The dataset was published openly on github.

In this study, the dataset was divided into train and test sets. The training set consists of 300 images and the test set consists of 40 images.

**3.2 The Architecture:** In this study we built a deep convolutional neural network using Google's Tensorflow Library to classify x-ray images of pneumonia and Covid-19 patients. Our proposed Neural Network architecture is summarized in Table-1:

**Table:1**

| **Layer (type)** | **Output Shape** | **Parameters** |
|---|---|---|
| conv2d_1 (Conv2D) | (None, 799, 599, 32) | 416 |
| activation_1 (Activation) | (None, 799, 599, 32) | 0 |
| max_pooling2d_1 (MaxPooling2 | (None, 399, 299, 32) | 0 |
| conv2d_2 (Conv2D) | (None, 398, 298, 32) | 4128 |
| activation_2 (Activation) | (None, 398, 298, 32) | 0 |
| max_pooling2d_2 (MaxPooling2 | (None, 199, 149, 32) | 0 |
| conv2d_3 (Conv2D) | (None, 198, 148, 64) | 8256 |
| activation_3 (Activation) | (None, 198, 148, 64) | 0 |
| max_pooling2d_3 (MaxPooling2 | (None, 99, 74, 64) | 0 |
| flatten_1 (Flatten) | (None, 468864) | 0 |
| dense_1 (Dense) | (None, 64) | 30007360 |

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| | | |
|---|---|---|
| activation_4 (Activation) | (None, 64) | 0 |
| dropout_1 (Dropout) | (None, 64) | 0 |
| dense_2 (Dense) | (None, 1) | 65 |
| activation_5 (Activation) | (None, 1) | 0 |

In our CNN we have three convolution layers, each followed by one max pooling layer. Then there is a dense layer of 64 karnels followed by another dense layer of one neuron. Only in the last dense layer activation function is “sigmoid”. In all other layers the activation function is “Relu”.

The first convolution layer takes an input of 800*600*3 image and filters it with kernel size of 2*2. The second convolution layer takes as input the max-pooled output of first convolution layer and filtered it with kernel size of 2*2. For the third convolution layer it takes the max-pooled output of the second convolution layer as input. The output is then max-pooled again and passed to a dense layer.

To reduce overfitting data augmentation is used. Data augmentation is the process of increasing the amount and diversity of data. In this process no new data is collected rather already presented data is transformed. In our study, shearing and zooming augmentation operation is used. Also a dropout of value 0.5 was used after the first dense layer to reduce overfitting.

In our study Binary Cross Entropy is used as a loss function and Rmsprop is used as optimizer.

**3.3 Algorithm:** A deep learning approach is used in this study for image classification problems. Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks(ANNs). ANNs have various differences from biological brains. Specifically, neural networks tend to be static and symbolic, while the biological brain of most living organisms is dynamic (plastic) and analog.

Deep learning performs impressively in the field of image processing especially in medical imaging. It is used in different image classification problems with great success.

To learn about thousands of objects from millions of images, we need an algorithm with a large learning capacity. However, the immense complexity of the object recognition task means that this problem can’t be solved using ordinary algorithms. Hence the use of deep learning. A deep neural network can sort through thousands of images and figure out different features about them that is not possible using traditional algorithms.

Despite the attractive qualities of deep neural networks, and despite the relative efficiency of their local architecture, they have still been prohibitively expensive to apply in large scale to high-resolution images. Luckily, current GPUs, paired with a highly-optimized implementation

of 2D convolution, are powerful enough to facilitate the training of interestingly-large neural networks.

In figure 1 there is an explanation of our deep neural networks .

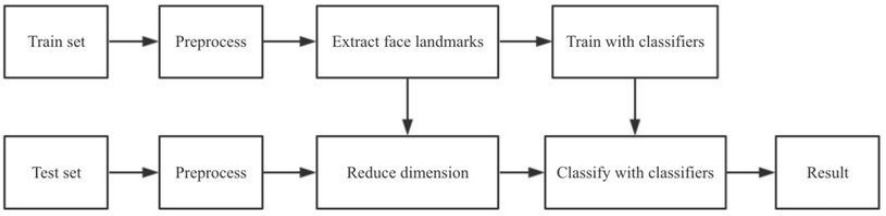



Figure : 1

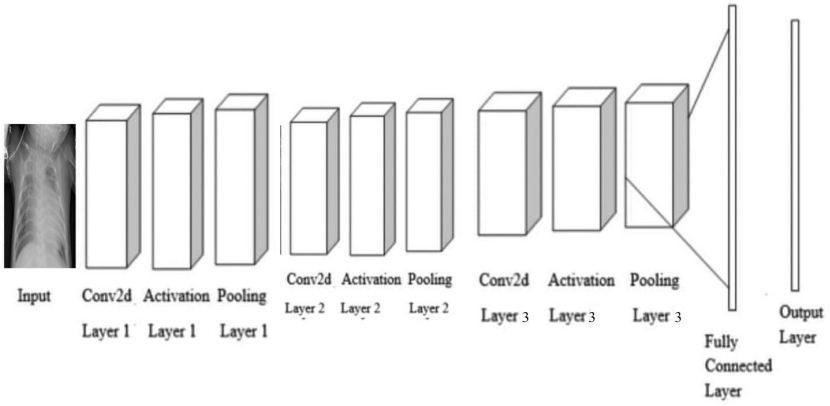



Figure: 2

In figure 2 there is a flow chart for our model.

**3.3 Procedure:** The steps that are followed in this study are given below.

(i) **Data Collection:** First X-ray images of Covid-19 and pneumonia patients are collected from the following source.
We got our data from github open library [12] and from our local source.

(ii) **Data preprocessing:** The collected data was then examined and processed as required. Different required image processing operations such as resizing, cropping etc were carried out. Data were then divided into train,validation and test data.

(iii) **Developing Model:** After preprocessing , a deep neural network is developed.

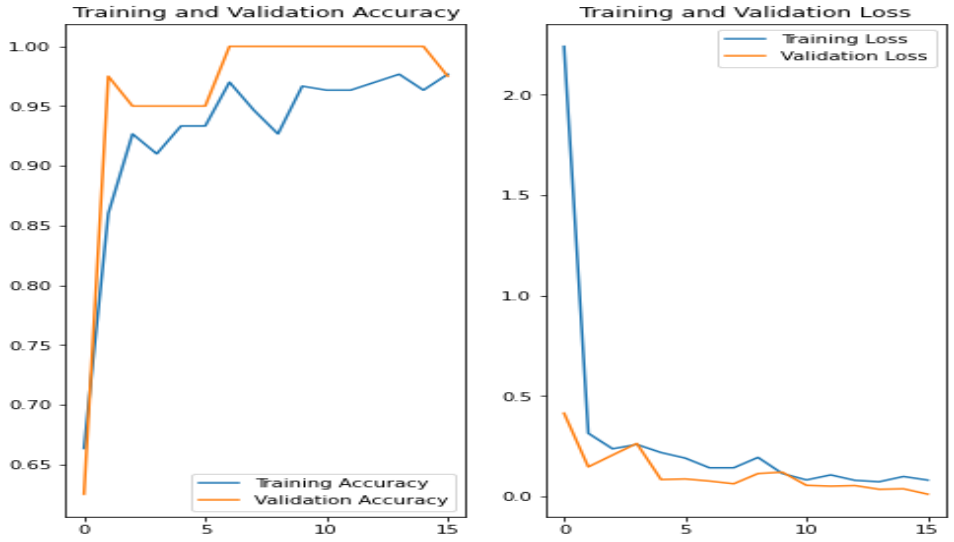
(iv) **Training the neural network:** The preprocessed data were then used to incrementally improve our deep neural networks ability to predict whether a given X-ray image is Covid-19 positive or not.

(v) **Evaluation:** Once the training was complete the model was then evaluated to see whether the network is performing to a satisfactory degree. In this step, the neural network was evaluated against data never used in training.

(vi)**Parameter Tuning:** After evaluation, different parameters were tuned to improve the neural networks performance.

## 4. RESULTS

In this study, chest X ray images have been used for classifying Covid-19 and pneumonia patients.A Convolution Neural Network was developed and trained on chest X ray images for this purpose. Final accuracy of this CNN is 92.61%. Accuracy vs epochs and loss vs epochs are shown in the following Figure-3.




The main problem in this study is the limited amount of Covid-19 X-ray images. When more images will be available we can improve our current model.

Value of Precision, Recall and f1-score for our developed CNN model are given in the following table-2.

**Table 2: Measured Results of CNN for predicting Covid-19 and Pneumonia**

| Algorithm | Predicted Actual | Covid-19 | Pneumonia |
|---|---|---|---|
| CNN | Covid-19 | 19 | 7 |
| | Pneumonia | 9 | 17 |

The confusion matrices of the result of this study using CNN, in Table 2. The calculated Precision, Recall, F-1 Score are shown in Table 3

**Table: 3 Measured Results of CNN using Two Class Labels**

| Algorithms | Class Label | Precision | Recall | f1-Score |
|---|---|---|---|---|
| CNN | Covid-19 | 0.52 | .55 | .54 |
| | Pneumonia | .53 | .50 | .51 |

## 5. CONCLUSION

The purpose of our study is to detect Covid-19 patients in early stages so that the spread of this disease can be prevented. A deep CNN model is proposed in this study to classify covid-19 patients from normal pneumonia patients . As the accuracy is significantly higher(almost 90%) we can say this model can predict Covid-19 patients quite accurately.

The main drawback of this system is the low amount of Covid-19 X-ray images. The accuracy can be improved with the help of a larger network. In the future with larger data accuracy can be significantly improved. Also by implementing transfer learning approach accuracy can be improved significantly.

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