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Detecting COVID-19 from X-Ray images

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ABSTRACT: Severe acute respiratory syndrome- one of the essential factors which is responsible for affecting people with CoronaVirus disease can be detected using X-Rays and has made a great life saving impact on people, considered as the most important test to be conducted to depict the disease in medical science at present. Most of the countries worldwide are not financially capable to provide the required number of covid-19 test kits to medical centers. A number of experiments using convolutional neural networks were performed. 14 experiments used state-of-art pre-trained networks, 10 experiments used around a count of 5 machine learning models for learning the knowledge gathered corresponding to Covid-19's effective detection using X-rays.

KEYWORDS: Syndrome, convolutional, pytorch, cheXNet.

I. INTRODUCTION

Coronavirus disease (COVID-19) is a disease caused by a newly discovered virus. .

The common cold is a coronavirus. Though sometimes, they develop a few newer tricks, and become far nastier- SARS was one such.

People who unfortunately get infected with the COVID-19 virus may experience mild to severe respiratory problems. Aged people, and those who suffer with underlying medical problems such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer are likely to be affected seriously with covid-19.

The coronavirus pandemic has been spreading rapidly to all other nations, it has reached to almost all the countries globally. It takes a duration of 14 days of incubation after which the infected person begins to show the signs and the symptoms of the coronavirus. The virus can survive on surfaces for a period of four days and above. It has caused the lockdown of some of the countries. The seriousness of the corona virus is felt based on the effects associated with the COVID 19.

The effect of covid-19 on our lungs can be determined by x ray but not only covid-19 diseases like pneumonia and bronchitis can too be detected using x rays, these conditions caused due to atelectasis and increased fluid can be possibly due to bacterial infection or viruses other than coronavirus. It helps to detect infiltration of lung tissue, a peripheral opaque anomaly usually presented in x-ray. This can probably directly confirm coronavirus, it gives suspicion of the disease and the patient is tested immediately.

The best way to at least slow down the rate of covid-19 virus is to educate people about its transmission and to maintain the personal hygiene and sanitation of the surroundings. To protect oneself from covid-19 personal sanitation should be maintained.

The COVID-19 virus spreads through droplets of the saliva. So when a person tested positive with covid 19 sneezes or coughs the virus transmits to the people close by. Following respiratory etiquettes are hence extremely important, like using a napkin to cover mouth and nose while sneezing or coughing.

II. MATERIALS AND METHOD

To test covid- 19 using deep machine learning there are first a few questions to understand to proceed forward with the neural network design-

1. Is it possible to determine if someone has COVID-19 without running laboratory tests?

Perhaps, but not with great certainty. Quite a few symptoms of COVID-19 that are very similar to other medical conditions such as flu, cold and allergies. So a combination of a questionnaire and/or image classification could get you somewhere, but perhaps not as far as to make a definitive diagnosis.

2. Is it possible to determine if someone has COVID-19 with a blood test?

Yes, and we may not need ML, it can be done by a standard virological blood test.

3. Is it possible to determine if someone has COVID-19 from CT scans?

Yes, and this is conceivably the one case where ML can be very useful and outperform other testing methods.

Dataset -

To get started with a supervised learning model we will be requiring the dataset related to analyze and discover different similar occurring patterns in the dataset. Scan through the columns and the test data to analyze number of infections or deaths by COVID-19, for eg. temperature, age, etc may be important factors. You can plot the graphs for visualizing data. After that, training a model with sample test data to check how good the model is. Rest things depend upon your creativity, intellectual & dedication, I just told from a very basic point of view.

A number of x-ray images were accessed from different sources.

Design of experiments -

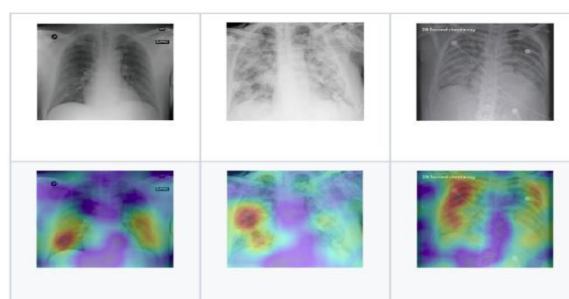
Using predictive computer models for drug discovery is not new but the best success so far. As per the research conducted the predictive models do what traditional models would, with less financial investments.

The collection of various test cases is crucial to feed the data accordingly. The different test cases of interest to this project are as follows:

1. X-Ray chest images for negative cases.
2. X-Ray chest images for positive cases.
3. X-Ray test cases for diseases like pneumonia.

Visualization -

To help to demonstrate our results qualitatively, generation of saliency maps for model prediction using RISE is done. Some of the saliency maps on covid-19 are as shown:



III. MODELING AND ANALYSIS

Convolutional Neural Network is a Deep Learning algorithm. That is used in Natural Language Processing and image recognition. Convolutional Neural Network (CNN) considers an image and helps to identify its features and further predict it.

Some of the variations in neural networks have significantly helped in advancement of deep learning, and one among those- convolutional neural networks (CNNs). CNNs are specific classes of deep neural networks that help in visual imagery analysis.

Significant advancements have been made with visual analysis using deep learning that is pushed further forward with convolutional network, which can be present in a deep neural network. If a network has a convolutional layer, then they are referred to as CNNs. One of the most powerful properties of a CNN is that it can detect images with features such as light, dark, specific spots of color, edges in various orientations, patterns, and more.

Using some of these basic features, a CNN can then be used to detect more advanced ones such as a dog's ears, a cat's nose, a person's lips, or certain shapes. For any regular neural network, the task of detecting advanced pictures using pixels of an image is not easy. These features can be in different orientations, differing size and shapes. For example, movement of an object in the plane or the angle of capturing the picture by a camera can drastically affect the picture's features, even though the object looks exactly the same to our eyes.

Data distribution

Image distribution of chest x-ray

Type	Normal	Bacterial Pneumonia	Viral Pneumonia	COVID-19	Total
Train	1341	2530	1337	115	5323
Val	8	8	8	10	34
Test	234	242	148	30	654

Image distribution of chest x-ray

Type	Normal	Bacterial Pneumonia	Viral Pneumonia	COVID-19	Total
Train	1000	1353	1083	80	3516
Val	8	7	7	7	29
Test	202	77	126	19	424

IV. RESULTS

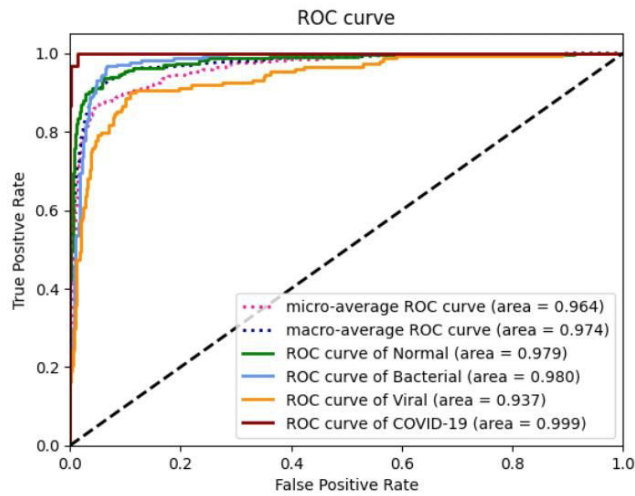
The results from Covid Ai Detector a pytorch based implementation used to identify covid-19 from x ray images, the prediction model takes chest x ray image as an input to the system and outputs the probability of covid-19 by giving the probability scores for 4 classes- (Normal, Bacterial pneumonia, Viral pneumonia and COVID - 19).

The result is based in terms of -

1. Per class AUROC (Area under Roc curve)
2. Lines of cheXNet

3. Confusion matrix

Pathology	AUROC	Sensitivity	PPV
Normal Lung	0.9788	0.761	0.989
Bacterial Pneumonia	0.9798	0.961	0.881
Viral Pneumonia	0.9370	0.872	0.721
COVID-19	0.9994	1.000	0.938



Ground Truth \ Predicted	Normal	Bacterial	Viral	COVID-19
Normal	178 (0.76)	12 (0.05)	43 (0.18)	1 (0.00)
Bacterial	2 (0.01)	233 (0.96)	7 (0.03)	0 (0.00)
Viral	0 (0.00)	18 (0.12)	129 (0.87)	1 (0.01)
COVID-19	0 (0.00)	0 (0.00)	0 (0.00)	30 (1.00)

V. CONCLUSION

Detection covid-19 from X-ray images of the chest is important for doctors to analyze a patient's current medical condition internally and then proceed forward with the most efficient treatment to cure the disease. A AI based modeling technique helps in both analyzing the images and discovering test patterns.

The number of images analyzed and detection time of COVID-19, average testing time = 0.03 images / sec reduces computational cost and gives high performance.



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