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# REVIEW ON COVID DETECTION USING X-RAY AND SYMPTOMS

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**Abstract -** *COVID-19 which is caused by SARS-COV-2 Virus was declared as a pandemic by the World Health Organization in the year 2020. Since then, the virus has been imparted in over 44 million population and deceased over 5.6 million lives globally. It has affected people mentally, physically and shaken the global economy as well. With the explosion of virus, there also arises the need to find an effective & feasible method to detect the virus.*

*Also, Artificial Intelligence and Deep Learning has grown exponentially in the last few years and the Data Science communities has also contributed against this pandemic globally, moreover it is prominently playing a key role in image classification which also includes medical imaging. Convolutional Neural Networks (CNN) have been effective in detecting many diseases already. Therefore, there is considerable prospect that it will detect COVID-19 infected patients with images of Chest X-Rays and CT scans. With insight from different papers, our study in this project aims to propose a model for detecting COVID-19 disease through chest X-Ray images. Publicly available datasets have been used for our project and the concept of CNN have been taken in use. Our model provides an accuracy of about 96.5 %. It can be enhanced by taking a larger number of datasets for training the model.*

***Key words:*** **COVID-19, Coronavirus, X-Rays, Chest X-Ray images, Convolutional Neural Networks (CNN), Deep Learning, COVID-19 Detection.**

## 1. INTRODUCTION

The COVID-19 outbreak has become a severe health issue which has been a middle of media attention since March 2020. As of March 2022, two years since the covid outbreak, there have been about 446,911,134 confirmed cases across the globe, including 6,022,266 deaths. The data which have been collected during these times state that, USA has the highest number of cases followed by India, Brazil, France, UK and so on. With the increase in the number of cases of COVID worldwide, the most common symptoms that have been observed in people are fever, cough, tiredness and loss of taste or smell, but there are also a large number of cases, where covid infected people are asymptomatic. For people with non-young ages & elderly people who have chronic diseases, COVID-19 virus may progress to more serious infections like difficulty in breathing, chest pain, pneumonia and even death in many cases. The mortality rate is higher in elderly patients as the virus comes up over the immunity of those people easily. To stop or reduce the rate of spread of virus, many countries imposed strict lockdowns, social distancing norms and parallelly they performed diagnostic tests to frontline workers and general people to detect the COVID positive cases and isolate affected people and treat them in a prescribed manner.

The diagnosis of this virus is done by RT-PCR (reverse transcription - polymerase chain reaction) tests across the globe after collecting proper respiratory tract specimens, but it is a laboratory-based test, is time consuming and also not cost effective. Therefore, there arises the need to develop new low-cost rapid diagnostic tools to detect the virus. On the other hand, the recent development of technology in Deep Learning and processing of medical images has offered support for the development of diagnostic tools against this virus. Several studies have concluded the potential of using X-Ray & CT Scan images to diagnose COVID-19 patients. Both can yield similar results but as X-Rays are less expensive than CT scans, they are more favoured and can be used by many nations which have scarcity of resources. There are many researches that have stated different techniques and models to differentiate COVID positive patients from others by using the concept of Convolutional Neural Networks (CNN). Like many other image classification techniques, CNN has been performing extremely well with medical imaging. Already it has been widely used for the detection of different diseases or anomaly detection.

In this paper, we have proposed a CNN model to detect COVID positive patients from chest X-Ray images. Within a short duration of time and resources, this model successfully detects people who are infected with coronavirus with good accuracy. This might help to implement testing of COVID-19 even on a larger scale which would really save time and money.

## 2. LITERATURE SURVEY

CheXNet algorithm [10] which is used to diagnose and detect pneumonia from chest X-rays. To achieve higher accuracy than the experienced radiologist by making some changes to it made a Convolution Neural Network (CNN) algorithm to diagnose 14 pathological conditions in the chest X-ray. Trained the model using a dataset of 550 chest x-ray images collected from the Kaggle website. Prediction accuracy of 89.7% was achieved which was closer to the CheXNet

algorithm. The algorithm was trained multiple times to increase the model accuracy on different sizes of datasets. Also, the same data has to pass multiple times to the same Neural Network to improve the learning process. The lack of a huge dataset acted as a huge barrier to achieving higher accuracy. Through experiment, it is noted that an increase in the training sample achieved more accuracy in the identification of Covid-19 in human samples.[1]

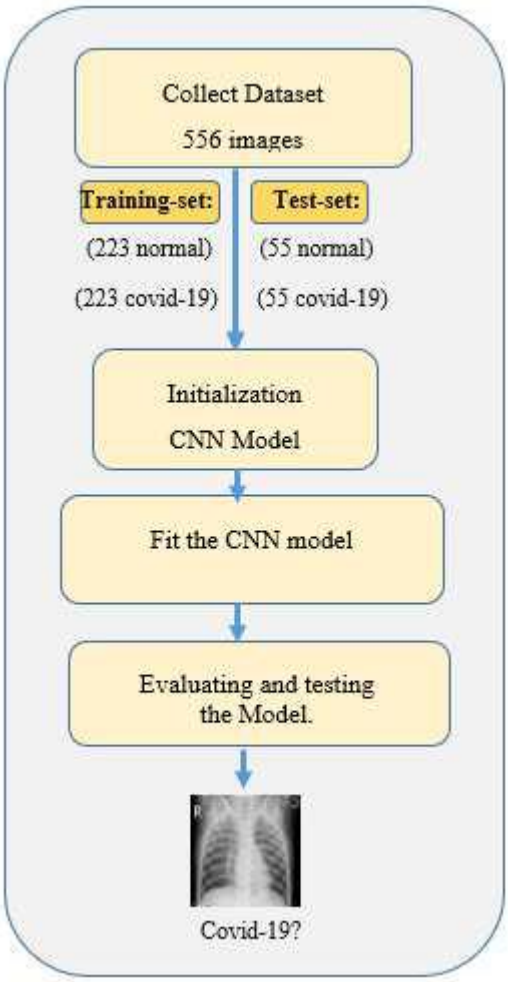


Fig. 1. The proposed CNN model for Covid-19 detection.

Data Science and AI have contributed a lot in the past, to find solutions to problems. For global response against the new coronavirus, Covid-19 special attention is given to developing rapid diagnostic tools used for the detection of covid-19 using Chest X-rays using the deep CNN model. To train the model, transfer learning has been used. Two different sets of the dataset are used. In this paper, an evaluation of several pre-trained deep CNN models on the detection of positive cases of the covid-19. After evaluating the different types of CNN models, best performing models among the evaluated ones were the DenseNet, ResNet, and Xception models having high accuracy in predicting the Covid-19 using the chest X-ray.[2]

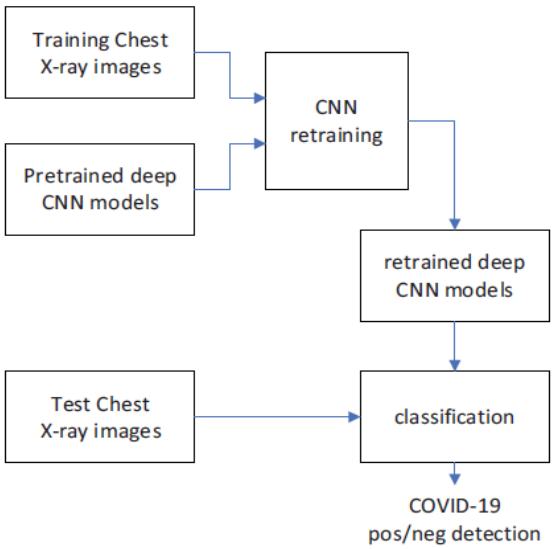


Fig. 2. Block diagram of the evaluated architecture for COVID-19 detection.

Deep learning has been playing a great role in the medical field for the detection of several diseases like Coronary Artery Disease, Malaria, Alzheimer's disease, different dental diseases and many more. Since CNN plays a great role in image classification. It has been used for the detection of Covid-19 using chest X-rays. As for a covid patient, every day is important so to eliminate the day for testing the specimen taken from the patient, this method is very efficient as it gives the results with a very little amount of time and resources at a very cheap cost. This helps the patient to take treatment early and also helps the government to implement testing of Covid-19 on a much greater scale which is very essential to stop the spread of covid-19.

In this paper, a CNN model is developed and its evaluation is done with a comparative analysis of two other CNN models. A good accuracy model is achieved although a limited dataset is available, data augmentation is used such as random horizontal flipping and random cropping.[3]

Since Covid-19 is spreading rapidly in the world, there is a huge shortage of medical testing kits all over the world. So, using the deep Neural Network model can overcome the problem of the shortage of testing kits. By using transfer learning, a Residual Network (ResNet) model is developed by changing different hyper parameters like learning rates and dropout values to achieve good accuracy. During the experiment, as there was a huge shortage of datasets, achieving higher accuracy became very difficult. Since it is illogical to develop a model from scratch with a small dataset, two models ResNet-34 and ResNet-50 which are pre-trained on the huge datasets are trained and achieved decent accuracy. Also observed that by increasing the layers and by changing parameters the accuracy of the developed model will definitely increase.[4]

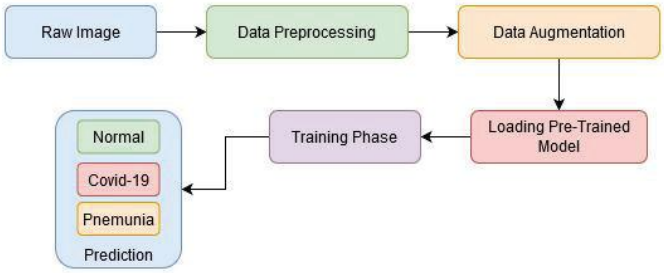


Fig. 3. Schematic representation of experiment setup of Covid-19 detection.

Using Radiology to diagnose the patients that have COVID symptoms. They discovered that the most used method to test this disease is RT-PCR Test, which is a time-consuming process, also transporting of samples requires time. To reduce the duration of the process and to make it less hectic, he proposed a solution to use radiography images of the human chest like X-Rays and CT scans. But X-Ray image detection is preferred over the other as it is cost-effective. Here, they've used the concept of CNN (Convolutional Neural Networks) as they demonstrate high accuracy results in the use case of image & object recognition. There are several models of CNN which have evolved over time, but the most common and majorly used models are ResNet and DarkNet models. The researchers of this paper have implemented a unique 19-layered CNN structure which determines the detection of coronavirus and differentiates it from pneumonia. They created their dataset by collecting COVID positive x-ray images, x-rays of normal lungs, and images of lungs infected with pneumonia from publicly available repositories. For training their model, they had 600 images and they decided to select 100 images as corona positive, pneumonia each and the rest 400 as non-infected images. They created a model named Covid Aid model which is as follows:

- X-Ray Images
- Data pre-processing
- Training phase
- Covid / Pneumonia / No findings.

The architecture of their model was influenced by DarkNet's model architecture. They made 19 layers of convolution in which 7 were single layered and 4 as triple layered structures, along with max-pooling layers and then they used several operations in their architecture.

Their model Covid Aid Model achieved 87% accuracy in multiclass classification of 3 classes namely: Covid/ Pneumonia/ No Findings. The limitation which they faced was the limited availability of high-quality images for training their dataset. But they proposed that their model can be used effectively in remote areas which don't have access to testing kits or medical experts.[5]

The authors of Papers made thorough research on several papers and studied about the outbreak of Coronavirus which they concluded that first transmitted from live animals to humans and then human to human. They identified the problems faced by the citizens who were stranded for hours at the laboratories for taking RT-PCR tests, like overcrowding which can lead to more cross-infections and spread the virus, also the lower number of radiologists available at the test centres; so, the authors proposed an approach of making use of AI and Machine Learning algorithms with a vision to eliminate the cost, time and other resources. They have selected the best Deep Learning models to detect and diagnose the segment of lungs, and predict the infected patients using Deep Learning techniques.

They have presented the summary of their work on classification, segmentation & prediction in tables. They compared the performance of approx. 40 models by altering the datasets, model Kits like X-Ray Images/ CT scan images or both. Many DL models out-performed other models based on accuracy, number of training cases, etc. Limitation which they observed was the smaller number of datasets available for training their model.[6]

The researcher has created a Convolutional Neural Network model and pre-trained on different architectures like MobileNet,DenseNet, for feature extraction of X-Ray images. The output of CNN model is Matrix form, this output is given to the Dense layer for training. Next procedure of Dense layer training was done on Machine learning algorithms Bayes,RF, MLP, SVM, kNN. The method of extract-classifier pair combination, is resulting in achieving very good Accuracy. For one dataset combination of MobileNet architecture and SVM linear kernel classifier archives the accuracy and F1-score of 98.5% on the other hand for second dataset DenseNet201 as extractor and MLP as classifier gives the best accuracy and F1-score 0f 95.6%. The solution in the paper has not undergone clinical study, though this system is fast, accurate and automatic. Only limitation of the paper is the small dataset, which consists of 388 images out of which 194 images are normal chest X ray and 194 images are COVID-19 positive X-ray images. The limitation can be overcomed by more dataset images and by clinical study of X ray.[7]

The group of researchers from Iran and Hungary have proposed a solution on Rapid and accurate diagnosis of COVID-19 from Computerised Tomography(CT) scans using Deep learning. The researchers have used Machine Learning, Artificial Neural Network(ANN) and Ensemble learning(EL) methods to find solutions.The single models include SVM,Naive Bayes,MLP and CNN on other hand ensemble models have AdaBoost and GBDT algorithm. Dataset includes 430 images of COVID-19 chest X ray while 550 images of normal chest X ray. The researchers have used 75% data for training and 25% data for testing. Out of many

algorithms CNN has 97% accuracy while SVM algorithm has 99% accuracy.[8]

Proposed a solution for early detection of lung detected COVID-19 using Chest X-Ray. It was classified using the Convolutional Neural Network architecture ResNet50 model. The dataset of 1200 images was collected from four different sources and has two different classes COVID-19 and non-COVID19. Then authors applied image augmentation for improving the training process. Final stage was to pretrained RestNet-50 CNN mode to extract deep features of chest X-Ray. The authors have achieved 99.5% classification excellent accuracy. Small size of the dataset is a limitation of the paper.[9]

## 3. PROPOSED SYSTEM

Chest X-ray and symptoms as input data: The data that is to be processed is collected, chest X-ray can be in any form such as a PNG, JPEG, JPG. Once the data is collected it is sent to the further stages. This model is easy to implement because of the fact that it requires very few devices or software for it to work. X-ray resizing: The X-ray image given as input could be of any size. As the model needs a specific size for predictions it needs to be resized else it results in an error. A resized X-ray image is given to the further stages for predictions. Predictions: The resized chest X-ray image is directed to the trained CNN model for predictions while the symptoms which are given as input are converted into the NumPy array and given to the decision tree machine learning algorithm for prediction.

Results integration: The predictions of the models get integrated to give the results. Integration of results is done in the following ways: If both the models conclude the covid present, it is confirmed that the user has covid. If both the models conclude the normal as output, it is confirmed that the user is concluded as safe. In case of conflict, priority is given to the X-ray, and the user is informed to take medication and follow covid protocols. Output of the system : The outcome of the system will have the domination of results given by the CNN model as the result was generated using an X-ray which is generated by scanning the lungs. A patient can be symptomatic or asymptomatic; it differs according to the immune system of one's body. However, prediction based on symptoms supports the predictions made by the CNN model.

## 4. ADVANTAGES AND LIMITATIONS:

### 4.1. Advantage

1. No need for a test kit or huge infrastructure.
2. Patients can be tested by maintaining social distance and without much interaction with doctors.
3. No need for collecting any specimens from the patient.
4. Highly cost-effective and quick results can be achieved, handy when mass covid-19 testing is needed.
5. Waiting time for the results of the patient will be avoided, the patient could get medical treatment on time.
6. Do not need an extra medical professional.
7. The system will provide accurate and unbiased results.

### 4.2. Limitation

1. A very huge dataset with proper authorization is needed to achieve higher accuracy.
2. Produce wrong results if data augmentation is not done while used in the real world.
3. High accuracy is needed so that model is reliable to use.
4. Only a digital X-ray is needed for the model to detect.

## 5. APPLICATIONS

1. At government hospitals, where a huge crowd gathers for testing.
2. Testing poor people as they can afford it since it is cheap.
3. Testing of the critical patients where time is very crucial for saving life.

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