IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Covid-19 Detection Using Deep Learning CNN Algorithm

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Abstract — The objective of this research paper is to build Covid-19 Detection system using machine Learning so it can reduce the efforts of radiologist can be faster and efficient to carry out final results.as we all know Covid-19 is a rapidly spreading viral disease that infects humans as well as animals are also infected because of this disease. Due to this deadly viral disease The regular life of peoples and the economy of a country are affected . Covid-19 is a normal spreading disease, and till now. These kind of patients are mostly infected from a lung infection after coming in touch with this disease and this has been shown by clinical study of COVID-19 one who infected.For diagnosing of lunge related problem Chest x-ray (i.e., radiography) and chest CT are a more effective imaging technique Still, a substantial chest x-ray is a lower cost process in comparison to chest CT. To provides useful analysis to study a large amount of chest x-ray images that can critically impact on screening of Covid-19 ,Deep learning is the most successful technique used. For covid-19 affected patients as well as healthy patients, for this work We have used the PA view of chest x-ray scans. By applying data after cleaning up the images augmentation, we have used deep learning based CNN models & compared their results. We have compared some Inception V3 and Xception, and ResNeXt models and examined their accuracy. To analyze the model performance, 120 chest x-ray scans samples have been collected from the Kaggle and github, out of which 5007 were used for training and 900 for validation purpose. In result analysis, the Xception model gives the highest accuracy 98% for detecting Chest X-rays images as compared to other models such as Darkcovid. This work only focuses on methods of classifying covid-19 infected patients and does not claim any medical accuracy..

I INTRODUCTION

A Bunch of mysterious cases of pneumonia were detected in December 2019 in the province of Wuhan, China, which eventually spread to the rest of the world. Initially, a few cases were reported in the Europeann countries Italy france and Germany, Then it increased to every country around globe. The infection has spread to some cruise ships in china and cruise operators have begun starting cancel or to change their routes as countries around the world have introduced travel restrictions to control the spread of disease As of 1 May 2021, 3,195,190 people died of COVID-19, while 155 million cases in 210 countries were reported in 129,381,992 cases. Chart for number of cases of COVID-19 across the world. Figure 2 shows Number of deaths due to COVID-19 across the world

COVID 19 is an infectious illness triggered by the recently identified coronavirus virus. It was not understood until the outbreak in Wuhan, China, started in December 2019 .The most frequent signs of COVID-19 include fever, tiredness, and dry cough. Most individuals (about 80 percent) are healing from the disease without needing extra treatment. Approximately 1 of every 6 people that have COVID-19 are seriously ill and experience trouble breathing. Senior citizens and those with chronic medical issues such as elevated blood pressure, cardiac disorders and diabetes are more prone to experience severe illnesses . Evidence to date has demonstrated that the virus that triggers COVID-19 is mainly spread by interaction with respiratory droplets rather than through the airPneumonia is a type of acute respiratory infection that affects the lungs .The lungs are made up of little pockets called alveoli, which are packed with oxygen as a stable person breathes. When anyone has pneumonia, these alveoli are packed with pus and blood, rendering ventilation painful and therefore raising the absorption of oxygen. Symptoms of pneumonia can involve fever, trouble

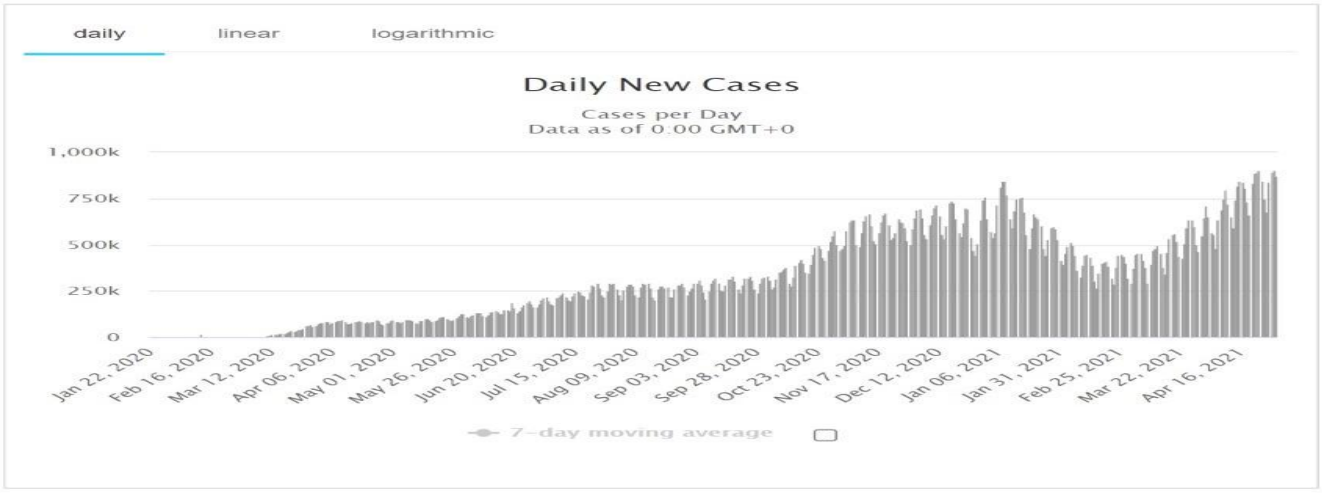


Fig 1

Chart for number of cases of COVID-19 across the world

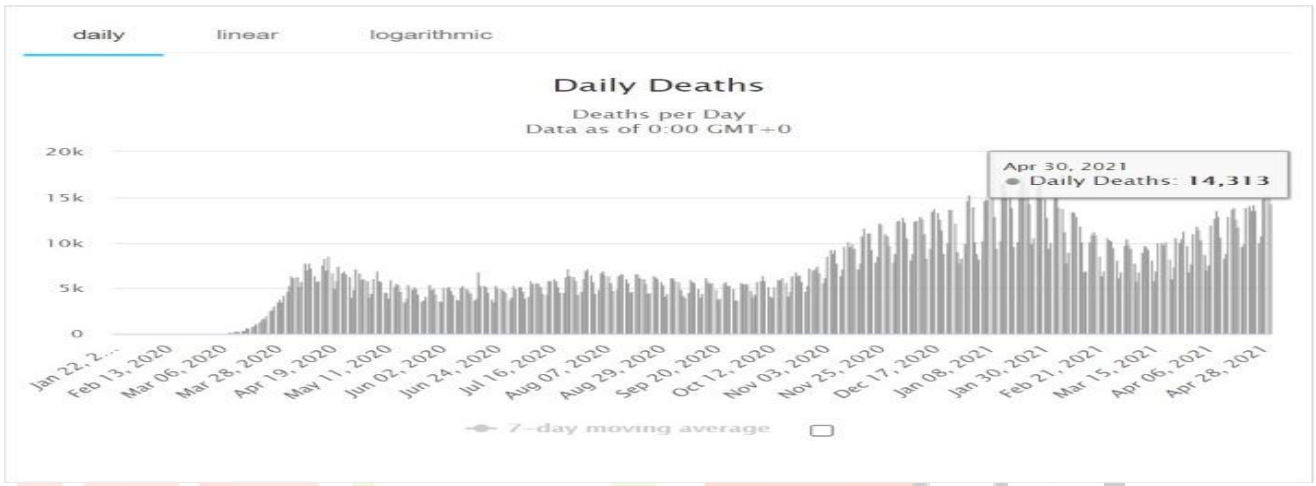


Fig 2

Number of deaths due to COVID-19 across the world

The systema respiratorium(Chest and internal part). is the most Essential organ of the body most affected by the virus, so the use of X-rays of the chest may prove to be a more efficient way than the thermal screening and other oprtion of screening the human body. Image Recognition tasks have progressed in recent years due to advances in algorithms and, the availability of large datasets and powerful GPUs that allow deep Convolution Neural Networks (CNNs), Residual Networks and training methods such as transfer learning have produced state-of - the-art performance for tasks such as image recognition and classification.in some RTCPR test sometimes its showing false result The standard testing procedure may generate results within a few hours to two days. There is therefore a significant need for advanced technologies to screen future COVID-19 patients. In section 5, we applied an approach to classifying COVID19 positive patients based on X-Ray Images. The symptoms of pneumonia and COVID-19 are somewhat similar and the respiratory system is the most affected area of the human body, so screening based on the respiratory system using XRay would be a safer and efficiant way

II. RELATED WORK

From last few years computer aided diagnostic (CAD) ufor medical imaging has been used. Beginning from a conventional way to artificial intelligence method and from machine learning to deep learning approach, this due to the high-performance result . Several techniques have been applied for classifying diseases like cancer, skin illnesses, chest diseases, and many others. Deep convolutional neural networks (DCNN) with increased dataset collections are the most used methods for classifying numerous types of medical images with its high-accuracy result.

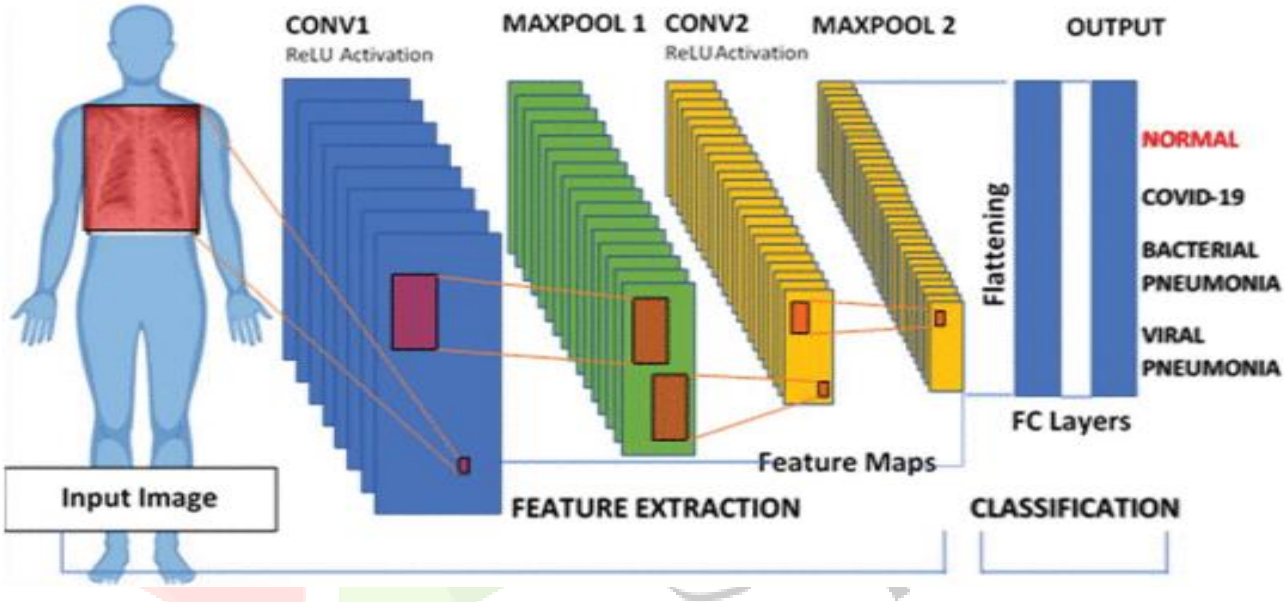
Deep Learning:

Learning in a DL approach is a process of developing behavior based on the learned features or its experience. DL is a sub-field of artificial-intelligence and machine learning which improves its utilization found on the performance of different applications of artificial-intelligence and machine-

learning. Deep learning affects the acceleration of GPU-based computing power and nonlinearity that allows deeper networks for improved operation . Progressive researches in deep learning algorithm have increased rapidly and the resemblance of this was the diagnosis of pneumonia in the medical area is a wide-known discipline. A study for identification is done by applying image processing techniques. Algorithms developed cropped and extract the image of the lung region. It uses Otsuthresholding to segregate the healthy part of the lungs from the disease-infected part of the lungs. Sharma et al. investigated this approach that will help them assist in diagnosing patients in their study.

Convolutional Neural Networks:

Stimulated primarily by the human-brain, the convolutional neural network is a feed-forward neural network capable of classification and feature extraction process. CNN links 4 key layers: the convolutional layer, the rectified linear unit (ReLU) activation layer, subsampling layer, and fully-connected layer. The CNN process model is shown in Figure 1. A standard convolutional layer usually takes an input image and with the help of the kernel creates a feature map. Each neuron stores several inputs from the convolutional layer and several connections of neuron connection overlap each other to improve the representation of input images. The reduced number of parameters is the result form sharing of weights and every convolutional layer that connects to a ReLU activation layer offers the CNN additional acceleration for more complex functions. At times there is a possibility of overfitting in CNN, so the Pooling is applied a sub-sampling process that overpowers overfitting and lowers the number of parameters Lastly, fully connected layers with one or more numbers are complemented to encapsulate the trained-features to determine the categorized result. In this paper manuscript, the authors propose deep learning for classifying chest diseases like pneumonia and COVID-19. The paper allows showing the wide ability of CNN.



III. Materials and methods

Dataset:

X-ray images obtained from many different sources were used for the diagnosis of COVID-19. In the current chaotic situation in world, it's very hard to find the dataset for outbreaks like the COVID-19 pandemic, especially when most of the world is using thermal imaging instead of X-Rays to detect the infected persons. The X-Ray images of COVID-19 were extracted from online hosted data by Italian research organization, European Health Care.The Pneumonia X-Ray Images were collected from the open-source dataset . After removing the noisy images, a dataset with images for three labels COVID-19, PNEUMONIA, and NORMAL with 374 images in each label was extracted. As the number of collected images is very small, we further applied Data Augmentation steps such as Rotating all images to 45 degrees, zooming images to 30%, and height shifting with a factor of 0.2 were applied to the dataset to create diversity and will improve the quality of prediction. After this, all images were resized to 224x224 and the number of images in each label were made equal to remove the class imbalance issue. This dataset further divided into test, train, and validation set with test and validation provided with 35 images each and train set getting the rest. The dataset is released publicly with open access for researchers to experiment with methodology and further development at https://github.com/luckykumardev/Covid19- datas

Proposed CNN Architecture:

The CNN is constructed with numerous smaller units termed nodes/neurons which are arranged in the layered-architecture. These nodes comprise of weights that during the training of the model are updated using optimizing techniques like backpropagation etc. Every single CNN model is consists of the convolutional or feature extraction portion and the classification portion. The components and structure of the VGG-16 CNN model applied

Convolutional Layer: This layer forms a basic building block for convolutional neural networks. This layer uses a fixed-size filter to extract several features. The inspection of images is done by transferring the filters per strides, in this case, there are 6 convolutional layers with the size of 32, 64, 64, 128, 128, 128 filters in the CNN model. Every layer uses 2D convolutional filters with a size of 3x3 and a stride of one

Batch Normalization

It is used to improved the learning rate of the CNN model and this layer standardizes the input image. Batch normalization in a CNN model is applied after each convolutional-layer

Pooling Layer: Pooling is a method that downsamples the collected feature-map from a convolutional layer. Max-pooling and average-pooling are usually used and in every convolutional layer, a max-pooling with pooling filter-size of 2*2 is utilized

Activation

This function is a non-linear transformation of inputs that are applied at each end of a layer. ReLU or Rectified Linear Unit is a common activation function that is applied at each end of the layer and in the final layer, there are two nodes used with an activation function.

Dropout:

A technique applied to reduce the overfitting of the model. Certain nodes in the layer using the dropout method are randomly selected to be inactive on some occasions. This will prevent the model from getting excessively familiar with the data. The dropout of 0.5 was employed in the dense layers of the model for classification.

Dense Layers:The output of the convolutional-layer is further flattened and submitted as input to the dense-layer. The convolutional-layer task is to extract features and the role of the dense layer is for the classification of images. The CNN architecture has two dense-layers with 512-nodes each and 2 nodes for the final layer.

Layer (type)	*Output Shape*	*Param #*
Input	(224, 224, 3)	0
Convolution	(224, 224, 32)	896
Batch Normalization	(224, 224, 32)	128
Activation	(224, 224, 32)	0
Max Pooling	(112, 112, 32)	0
Convolution	(112, 112, 64)	18496
Batch Normalization	(112, 112, 64)	256
Activation	(112, 112, 64)	0
Max Pooling	(112, 112, 32)	0
Convolution	(112, 112,64)	36928
Batch Normalization	(112, 112, 64)	256
Activation	(112, 112, 64)	0
Max Pooling	(56, 56, 64)	0
Convolution	(56, 56, 128)	73856
Batch Normalization	(56, 56, 128)	512
Activation	(56, 56, 128)	0
Max Pooling	(56, 56, 64)	0
Convolution	(56, 56, 128)	147584
Batch Normalization	(56, 56, 128)	512
Activation	(56, 56, 128)	0
Flatten	100352	0
Dense	512	51380736
Batch Normalization	512	2048
Activation	512	0
Dropout	512	0
Dense	2	1026
Activation	2	0

Experimental Result:

The entire application was performed in 64-bit Windows10 Operating System using Python 3.6 version as the software development language. The entire experiment was coded in the Tensorflow framework to develop and train the model using Keras as the backend. The machine with Intel® Core™ i5-9000 CPU @4.60GHz with 12M Cache, 16GB DDR4 RAM is used for implementing the model. Data augmentation was also integrated during the conduct of experiments to increase the image dataset. Some of the methods applied are image-flipping, image-rotation, zoom-range, and shift-range. An Optimizer forms shapes the model into the utmost accurate achievable form by futzing with the weights , a learning rate of 0.0001 utilizing the Adam optimizer and a cross-entropy using categorical were adopted as optimization features A batch size of 32 and an epoch of 100 as shown in Table II the matrix result of the assessment of the Convolutional neural network model and diagrams of validation accuracy compared to accuracy and validation_loss compared to training_loss are showing in Figure3 as It shows the overall performance of the model that runs in a repeatitive steps to extract_features from the image during model-training presented in a plot. The result produced a 98% accuracy Chest X-ray image infected with Pneumonia viral infected with an accuracy rate of 96.95% and 93% respectively. The trained model is able attained an accuracy rate of 95% during the conduct of model training.

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As you can see in fig 4 we have achived the accuracy of 98% on the model The trained model attained an accuracy rate of 98% during the conduct of training

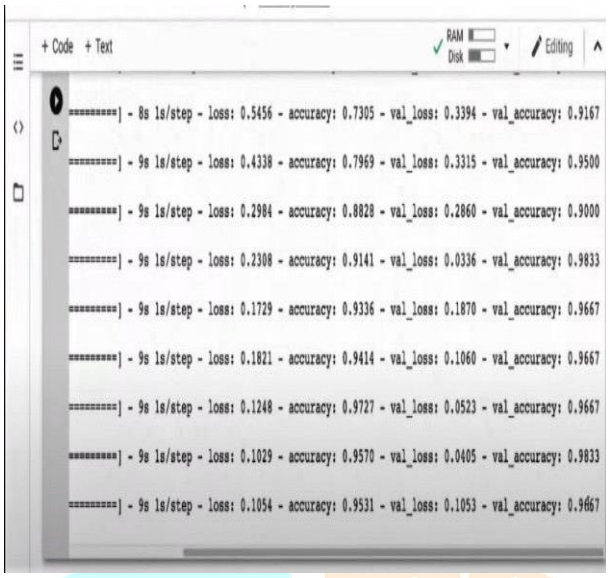

Fig. 4

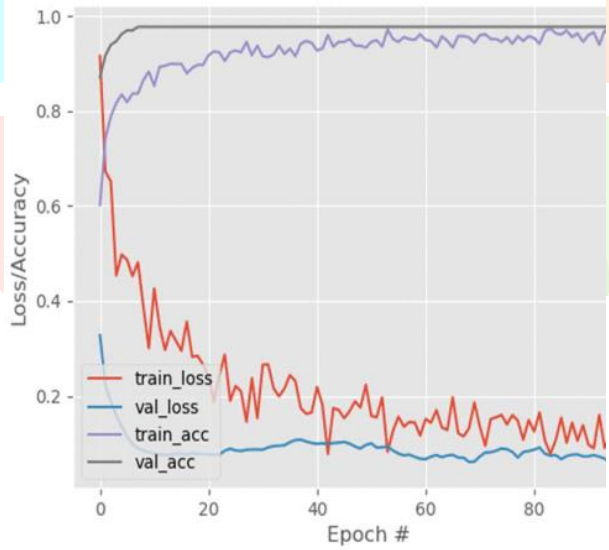

Fig. 3

Criterion	Normal	COVID-19	Pneumonia Bacterial	Pneumonia Viral
Precision	1.00	0.95	0.97	0.94
Recall	0.94	1.00	0.94	0.97
F1-Score	0.95	0.95	0.94	0.92

Table 2

Output:

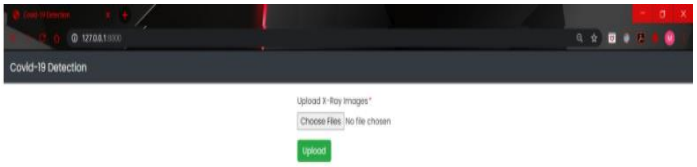

Fig. 5

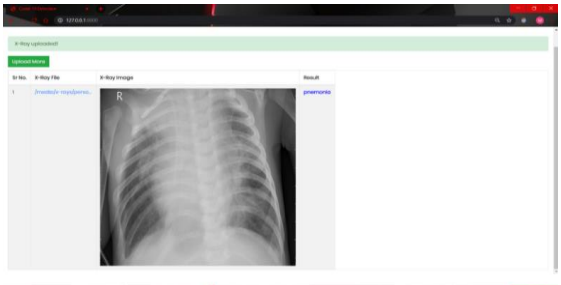

Fig. 6

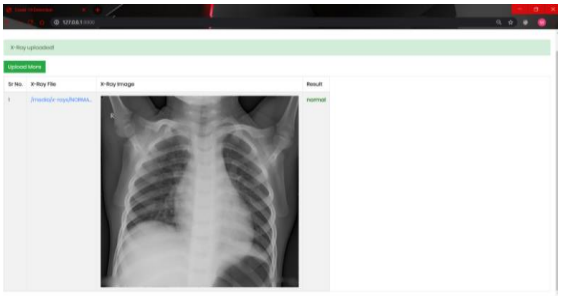

Fig. 7

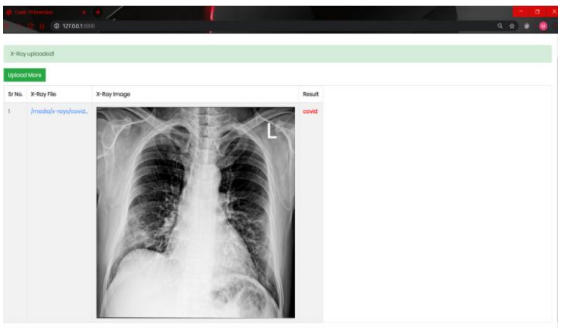

Fig. 8

Figure 5 shows and basic UI version where person can upload an image and they will get the result as shown in 6,7,8 images.

First X-Ray Fig-6 shows and person is infected with Pneumonia and in Fig.7 Shows and output as normal and the Fig. 8 Shows Covid-19 positive.

CONCLUSION & LIMITATION

Covid-19 pandemic is a growing manifold daily in entire world. Every country has do deal with large number of deaths and this is disturbing so we need rapid detection of Covid-19 so spread of this virus can be reduced it might can help health worker to reduce their burden, AI can play a big role in this pandemic by identifying Corona virus infected patient.

we experimented with multiple CNN Prebuild models in an attempt to classify the Covid-19 and normal patients using their chest X-ray scans images . then we concluded that out of these three models, Darcovid and the XCeption net has the best performance and this can be used for project. We have successfully classified covid-19 and viral Pneumonia scans, and it helps the possible scope of applying such AI techniques in the future to automate diagnosis and Detection tasks. The high accuracy obtained may be a cause of concern since it may be a result of overfitting so we used heat maps. This can be verified by testing it against new data that is made public available on github and kaggel, the large dataset for chest X-rays of positive and negative can be considered to validate our proposed model on it. It is also suggested to consult any medical professionals for any practical use case of this project. We as team do not intend to develop a perfect detection solution but only research about possible economically feasible ways to help to detect this disease. Such methods may be pursued for upcoming research to prove their real life implementation.

ACKNOWLEDGMENT:

The authors expresses their heartfelt gratitude to Prof. Sunil Khatal for there support and assistance for the project

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