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Covid Prediction via X-Ray Images

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ABSTRACT: The situation of novel corona virus (also known as COVID 19) is already on its peak, impacting more than 216 countries across the world. Infecting nearly 62 million people and killing over 1 million people. The worst struck countries are USA, India, Brazil, Russia and many European countries like France, Spain, UK and Italy. The virus is spreading at a very high rate and increasing its impact day by day. Many countries are facing the Third waves of the virus. It's been more than a year, since the first case of the virus was reported back in China (Wuhan province) in November 2019. The top vaccine/drugs producing and manufacturing companies working hard to develop an effective vaccine against the virus. The companies like Pfizer from US ad Pfizer from Germany have already started the trials and stated that their vaccines are more than 90 and 95 percent effective. The vaccines will surely be available in the upcoming year i.e., 2021.The research will also include the prediction of COVID 19 using X RAY scans. The model will predict, whether a person is infected with the virus or not, using his/her X RAY scan.
Keywords: COVID19, coronavirus, Machine Learning, X RAY images, Deep Learning, vaccines, WHO, Convolution neural network

I. INTRODUCTION

The corona viruses belong to the large group of viruses that causes illness ranging from common colds to fatal
diseases like MERS i.e., Middle
East Respiratory
Syndrome and SARS i.e., Severe Acute Respiratory Syndrome.

The novel coronavirus COVID 19 was first reported in Chinese province called Wuhan in late 2019. The virus of such kind has never been previously identified in humans. On 31st December 2019, a cluster of cases of pneumonia of unknown cause in Wuhan province, was reported to WHO i.e., World Health Organization. WHO, after seeing the increase of cases and deaths, declared the novel virus a 'Pandemic' [1].

Initially, the people were diagnosed with respiratory issues like shortness of breath, breathing difficulties. Some of people who got infected, did not show any symptoms. Remaining people who developed symptoms have mild to moderate symptoms initially, similar to the seasonal flu and fever.

The symptoms shown by the infected people are broadly divided into three groups. Most common symptoms which have been seen are fever, dry cough, tiredness. Less common symptoms include aches and pains, sore throat, headache, loss of taste and smell, diarrhea. Serious symptoms include difficulty in breathing, chest pain, loss of speech or movement.

The situation of COVID 19 in India is very poor. India is the second largest country hit by the coronavirus after US with over 9 million cases and over
100,000 deaths. The first case of COVID19 was reported on 30th of January 2020. With the population over 1.3 billion [7], it is important to control the spread of virus, requires special care and strong research.

The crucial steps in fighting and preventing COVID-19 is the ability to detect and isolate the infected patients early enough, and put them under special care so as to break the chain. When a new pathogen or a virus enters a territory where nobody has a low immunity, it can cause negative effects. As soon as the immunity builds up in a sample population, the relationship with the pathogen changes. With limited testing kits, it is near to impossible for every patient with respiratory illness or other respiratory disease to be tested using conventional techniques of RT-PCR. The tests also take long turn-around time, and limited sensitivity and efficiency. Detecting the possible COVID-positive infections on Chest X-Ray will help the

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frontline workers and officials quarantine the high-risk patients while test results are still awaited. As the X-Ray machines are already available in most healthcare systems nowadays, and with most modern X-Ray systems already digitized, there is no transportation time and cost involved for the samples either. In this project we propose the use of chest X-Ray to predict and diagnose the possible infected people and make an easy selection of patients for further RTPCR testing. This process may also be useful in an inpatient setting where the present systems are struggling to decide whether to keep the patient in the common ward along with other patients or isolate them in COVID-19 areas. It would also help in identifying patients with high likelihood of
COVID with a false negative RT-PCR report who would require a repeat testing. Further, we propose the use of modern machine learning and deep learning techniques to detect the COVID-19 patients using X-Ray images in an automated manner and help make the proposed testing technology scalable and effective. An infectious disease involves fast spreading, endangering the health of large numbers of people and weakening the health care infrastructure of the country. Therefore, our aim is to design predictive models for X-ray COVID19 prediction.

II. DISCUSSION

A machine learning framework was designed to predict the COVID19 from chest X-ray and Computed Tomography (CT) images [2]. Image tests can provide a fast detection of COVID-19, and consequently help to control the spread of the virus. Computed Tomography (CT) and Chest X-ray (CXR) are the imaging methods that play an important character in the diagnosis of COVID19 disease.

Due to the availability variety of large-scale annotated image datasets, great success has been achieved using convolutional neural networks (CNNs) for image recognition and classification.
The detection of COVID-19 infection is interrelated with both the symptoms of pneumonia and Chest X-ray tests. Chest X-ray is the first imaging technique that plays an important role in the diagnosis of COVID-19 disease i.e., whether a person in having COVID or not .

III. MATERIALS AND METHODS

- **Dataset**

In this study, we have taken the dataset which is publicly available on GitHub and Kaggle. The chest X-ray images of Covid-19 Positive patience's are taken from the Kaggle [13] and GitHub[14]. These repositories consisting of the X-ray / computed tomography (CT) images of 255 COVID-19 Positive
patients. In addition to that, 255 X-ray/ computed tomography (CT) images of 255 Normal Patients are taken from the Kaggle [13].

This data set is then divided into training and testing dataset. Testing Dataset is consisting of 10% of the original dataset, rest 90% of the Dataset is used as the training data. All the images were reshaped to 224x224x3 pixels in the dataset.

Classes / Dataset	Training		Testing	
	Covid-19	Normal	Covid-19	Normal
Dataset-1	230		25	
Dataset-2		230		25

Fig 1. No. of images per class of each dataset.

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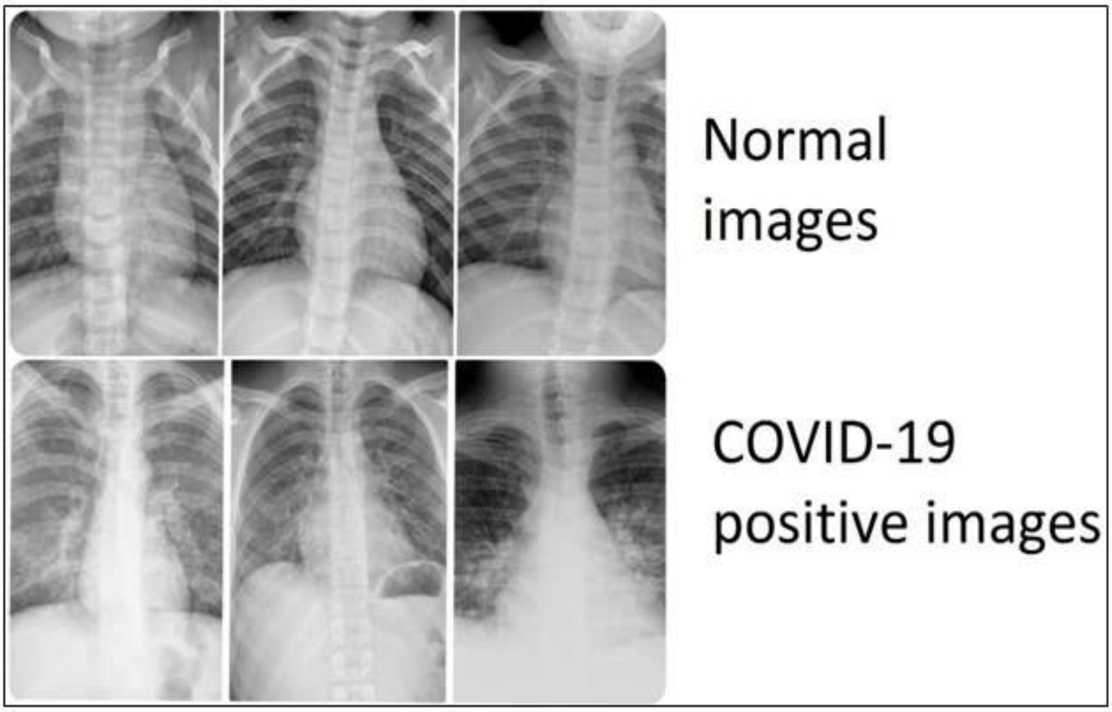

Fig 2. Representative chest X-ray images of normal (first row) and COVID-19 (second row).

- **Model Formulation**

The Dataset obtained from the Kaggle and GitHub repository is raw data and was cleaned as per the need. To work on the deep learning technologies, we require very large amount of dataset. In the field of medical-related issues it is not possible to have dataset (images in our case) available for every possible case.

For the better analysis of the available dataset, deep learning model is constructed using CNN (convolutional Neural network) [10],[11],[12]. In the given model we have implemented ReLU activation so that during the backpropagation process, not all the neuron's weight and biases get updated. We used Sigmoid function after ReLU in last 2 layers. The input to this function is now transformed into value from 0.0 – 1.0 and gives us the binary result i.e., 0 for Covid-19 positive and 1 for Covid-19 negative or Normal [4].

The given deep leaning model is newly constructed model using various convolutional layers followed by the maxpooling layers and dropout layers that is used to randomly drop few parameters to avoid the case of overfitting of the Dataset. After several sequential layers two Dense layers are added one with the ReLU activation and followed by the Sigmoid activation function.

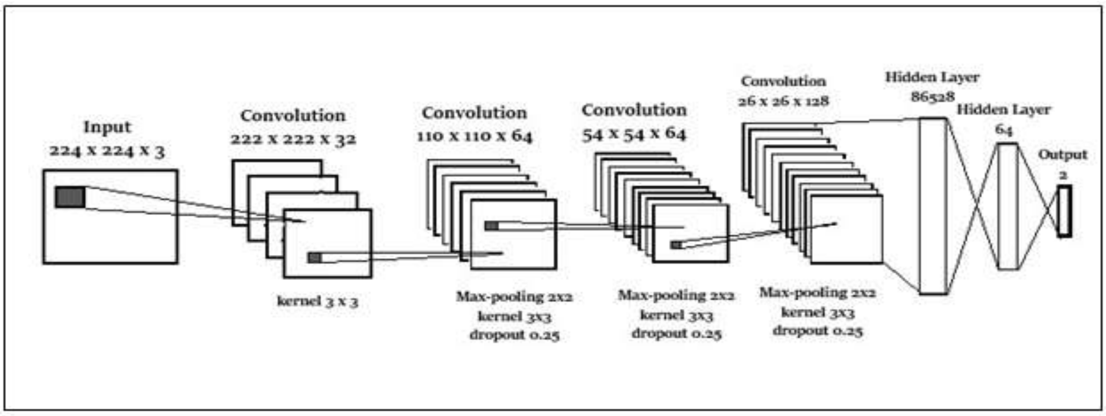

Fig 3. Model image

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 222, 222, 32)	896
conv2d_1 (Conv2D)	(None, 220, 220, 64)	18496
max_pooling2d (MaxPooling2D)	(None, 110, 110, 64)	0
dropout (Dropout)	(None, 110, 110, 64)	0
conv2d_2 (Conv2D)	(None, 108, 108, 64)	36928
max_pooling2d_1 (MaxPooling2	(None, 54, 54, 64)	0
dropout_1 (Dropout)	(None, 54, 54, 64)	0
conv2d_3 (Conv2D)	(None, 52, 52, 128)	73856
max_pooling2d_2 (MaxPooling2	(None, 26, 26, 128)	0
dropout_2 (Dropout)	(None, 26, 26, 128)	0
flatten (Flatten)	(None, 86528)	0
dense (Dense)	(None, 64)	5537856
dropout_3 (Dropout)	(None, 64)	0
dense_1 (Dense)	(None, 1)	65

Total params: 5,668,097
Trainable params: 5,668,097
Non-trainable params: 0

Fig 4. Description of the Model

Loss function used: Binary Cross-Entropy

We have used the **Binary Cross-Entropy** loss to train our model. It is used to optimize the value of parameters which are used in the model. Our motive is to decrease the loss function with successive epochs [3],[5]. We have also used Adam optimizer with a learning rate of 0.001 for training the model.

Loss=−sizeoutput1i=1∑sizeoutputyi logy^i+(1−yi).log(1−y^i)

- **Proposed algorithm**

The method which we have used for implementing the proposed model is discussed below [8],[9]: -

Step 1: Pre-process image i.e., image = X

Pre-processing used (We have utilized Keras preprocessing data generator for this purpose:

1) Reshape image (X) to (224,224)
2) Rescaling image(X) by 1. /255 3)Horizontal Flip = True
4) Zoom Range = 0.2
5) Shear range = 0.2

Step 2: Apply the image to an input of the Constructed model

Step 3: Fetch the output of the latter convolution layer of the given model.

Step 4: Flatten the dimensions.

Step 5: Apply the dense layer.

Units = 64 for the model.

$Z = W*A + b$

where, W = Weights

and b = bias

Activation function = ReLU

$$f(x) = \begin{cases} 0 & \text{for} \quad x < 0 \\ x & \text{for} \quad x \geq 0 \end{cases}$$

<u>Step 6</u>: Apply the dense Layer for inference
Z=W∗A+b where W = Weights and b = bias
Activation function = Sigmoid

$$f(x) = \frac{1}{1 + e^{-(x)}}$$

```
Epoch 6/20
8/8 [==============================] - 6s 695ms/step - loss: 0.4031 - accuracy: 0.8658
Epoch 7/20
8/8 [==============================] - 6s 775ms/step - loss: 0.3793 - accuracy: 0.8438
Epoch 8/20
8/8 [==============================] - 6s 689ms/step - loss: 0.4066 - accuracy: 0.8398
Epoch 9/20
8/8 [==============================] - 6s 758ms/step - loss: 0.2871 - accuracy: 0.9023
Epoch 10/20
8/8 [==============================] - 6s 787ms/step - loss: 0.2952 - accuracy: 0.8828
Epoch 11/20
8/8 [==============================] - 6s 759ms/step - loss: 0.2098 - accuracy: 0.9414
Epoch 12/20
8/8 [==============================] - 6s 767ms/step - loss: 0.1788 - accuracy: 0.9453
Epoch 13/20
8/8 [==============================] - 6s 762ms/step - loss: 0.2204 - accuracy: 0.9297
Epoch 14/20
8/8 [==============================] - 6s 700ms/step - loss: 0.1882 - accuracy: 0.9264
Epoch 15/20
8/8 [==============================] - 6s 704ms/step - loss: 0.1703 - accuracy: 0.9351
Epoch 16/20
8/8 [==============================] - 6s 781ms/step - loss: 0.1428 - accuracy: 0.9648
Epoch 17/20
8/8 [==============================] - 6s 746ms/step - loss: 0.1931 - accuracy: 0.9336
Epoch 18/20
8/8 [==============================] - 5s 683ms/step - loss: 0.1678 - accuracy: 0.9524
Epoch 19/20
8/8 [==============================] - 6s 764ms/step - loss: 0.1629 - accuracy: 0.9453
Epoch 20/20
8/8 [==============================] - 6s 760ms/step - loss: 0.1581 - accuracy: 0.9437
```

Fig 5. Loss and Accuracy of the model while Training.

- **Experimental Setup**

Python which is an object-oriented programming language was used to train the proposed deep transfer learning models. All experiments were performed on Google Collaboratory (Colab) Linux server the Windows 10 Home operating system using the online cloud service with Central Processing Unit (CPU),

Tesla K80 Graphics Processing Unit (GPU) hardware for free [6]. In this model the images of normal chest X-ray/CT is compared with the X-Ray/CT images of the affected person. The accuracy of the model is quite good, but due to the scarcity of data we have trained the model using 510 images and recommend to train and test the model on the updated Dataset in the future. In the experiment, we have trained the model for the 20 epochs with the batch size of 32 using the GPU (Graphical Processing Unit) on the Goggle Collaboratory.

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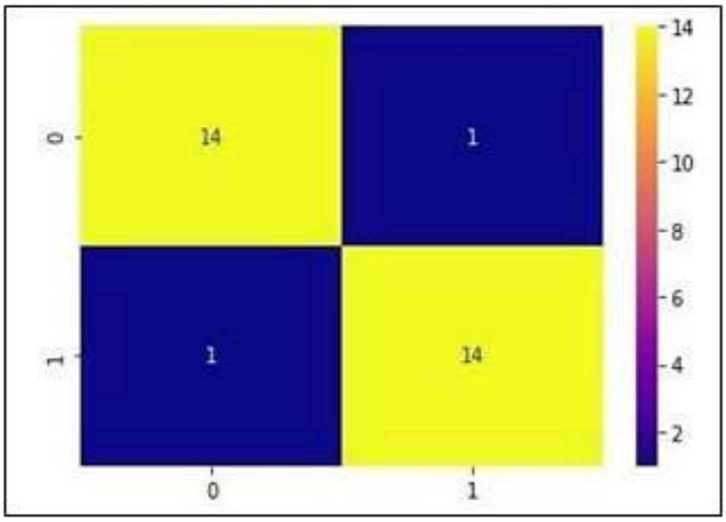

Fig 6. Confusion Matrix

IV. CONCLUSION

In this research, we have presented the use of Machine Learning and Artificial Intelligence for the effective prediction and classification of COVID 19. The proposed methodology is trained upon Publicly available datasets on Kaggle and GitHub.

The algorithm used in the project is CNN (Convolutional Neural Network). The prediction comes out be around 93%. This brings down the time for testing the virus drastically. To make the model more effective and to make a clinically effective prediction of COVID 19, training with more datasets will be truly useful. In the future, we will more closely look for various enhancements associated with the model. The main achievement of Machine learning is to predict and help the human beings. Using the model, many serious illnesses can be cured and deaths can be prevented on time which is important for the humanity.

REFERENCES

[1]. Z. Ye, Y. Zhang, Y. Wang, Z. Huang, and B. Song, “Chest CT manifestations of new coronavirus disease 2019 (COVID-19): a pictorial review,” European Radiology, vol. 30, no. 8, pp. 4381–4389, 2020.

[2]. N. Chen et al., "Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study," The Lancet, vol. 395, no. 10223, pp. 507-513, 2020.

[3]. D. Wang et al., "Clinical

[4]. Characteristics of 138 HospitalizedPatients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China," JAMA, vol. 323, no. 11, pp. 1061-1069, 2020

[5]. S. Salehi, A. Abedi, S. Balakrishnan, and A. Mohd, "Coronavirus Disease 2019 (COVID19): A Systematic Review of Imaging Findings in 919 Patients," American Journal of Roentgenology, pp. 1-7, 2020.

[6]. Jaiswal AK, Tiwari P, Kumar S, Gupta D, Khanna A, and Rodrigues JJ. Identifying pneumonia in chest Xrays: A deep learning approach. Measurement, 145:511-518, 2019.

[7]. Das NN, Kumar N, Kaur M, Kumar V, and Singh D. Automated Deep Transfer Learning Based

[8]. Approach for Detection of COVID-19 Infection in Chest X-rays. IRBM, https://doi.org/10.1016/j.irbm.2020.07 .001, 2020.

[9]. Alqudah AM, Qazan S, Alqudah A (2020) Automated Systems for Detection of COVID-19 using chest X-ray images and lightweight convolutional neural networks

[10]. Tulin Ozturk, Muhammed Talo, Eylul Azra Yildirim, Ulas Baran Baloglu, Ozal Yildirim and U. Rajendra Acharya. Automated detection of COVID 19 cases using deep neural neworks with X-ray images.

[11]. MohdZulfaezal Che Azemin, Radhiana Hassan, MohdIzzuin Tamrin and Mohd Adli Md Ali. Covid 19 Deep learning prediction model using publicly available Radiologist 2020

[12]. Rachna Jain, Meenu Gupta, Soham Taneja & Soham Taneja & D. Jude Hemanth.
[13]. Deep learning-based detection and analysis of COVID 19 on chest X-ray images. 2020 Ali Narin, Ceren Kaya, Ziynet Pamuk. Automatic detection of Coronavirus Disease (COVID 19) using X-ray images and deep convolutional neural networks.
[14]. www.kaggle.com/praveengovi/corona hack-chest-xraydataset (Kaggle data)
[15]. www.github.com/ieee8023/covidchestxray-dataset (GitHub)