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X-Ray Based Covid-19 Detection System

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Abstract*— The World Health Organization (WHO) recognized COVID-19 as the cause of a worldwide pandemic in 2019. The disease is usually contagious, and those who are infected can quickly pass it to others with whom they originate into contact. As a result, observing is an effective way to stop the virus from spreading more. Another disease caused by a pandemic the same as COVID-19 is pneumonia. This is of-ten significantly unsafe for young-sters, individuals over 65 years getting on, and people with health issues or immune systems that are affected. In this paper, we have classified COVID-19 and pneumonia using deep transfer learning. We have used the VGG16 architecture, which was constructed by collecting dataset of COVID-19, Pneumonia and normal X-Ray images. Our main objective is to ease the work of radiologist by providing a Graphical User Interface which takes x-ray as input and can directly distinguish whether or not patient has COVID-19, pneumonia or is normal.

Keywords - COVID-19, Pneumonia, X-Ray, CNN and VGG-16

I. INTRODUCTION

Pneumonia (lung infection) is associated with Nursing acute pulmonic illness it's associated with Nursing inflammatory conditions usually induced by pathogens and different medical specialty agents. There are several distinguishing approaches for classifying respiratory disease. Based on different pathogens pneumonia is categorized into two i.e infectious and non-infectious. An awfully too bad coronavirus pandemic (COVID-19) seems to be the worst pandemic in history. The number of affected people was 360,960 in Asian countries on April 26, 2021, and is quickly growing. The virus is progressively and so is growing and so are often caught at any age, resulting in severe diseases. Besides respiratory diseases, the infection rate of COVID-19 is pretty high. CNNs is appropriate to deal with this kind of drawback. With technology development, a lot of metrics within which radiology-based technique is most popular; and most helpful are being created. However, the identification of respiratory disease and COVID-19 with X-ray pictures remains a colossal job, even for competent and skilled clinicians, as X-ray photos offer comparable location options for different sicknesses, as well as respiratory organ illness. Feature extraction with wonderful performance could also be accomplished within the classification within the CNN model. CNN will categorize sophisticated identity footage. Deep learning could also be accustomed to determine COVID-19 and respiratory disease, in keeping with new analysis. To resolve this kind of drawback, convolutional neural networking, or CNN, is a superb selection. This study will also assist fewer underdeveloped nations CXR analysis includes identification of a pectoral illness. The majority of studies, as well as chest X-ray imaging, have incontestable Associate in Nursing accuracy of 90–94. The pre-trained models for Image Classification are VGG-16, ResNet50, InceptionV3 and Efficient Net .We've selected VGG-16 as our design. The VGG-16 is one of the foremost widespread pre-trained models for image classification. Introduced within known ILSVRC 2014 Conference, it had been and remains the model to beat even these days.

II. LITERATURE SURVEY

Automatic Detection of COVID-19 from Chest X-ray Images with Convolutional Neural Networks (1)

To deal with these problems, the CNN primarily based model is planned during this paper for detection COVID-19 cases from patients' chest X rays a group of 330 chest X-ray pictures that are equally divided into 2 classes: 'COVID-19' and 'Normal', are used for coaching the model. Similarly. This model performs with accuracy and exactitude of ninety-seven. 56% and 95.34% severally. This model is improved more with the provision of the larger dataset.Although the planned model shows promising results, it's by no means clinically tested. (1)

Detecting SARS-CoV-2 From Chest X-Ray Using Artificial Intelligence (2)

CXR images of 262 patients with Covid symptoms, and 1583 images of patients with diagnosed pneumonia, were obtained from the Kaggle COVID-19 chest X-ray dataset.

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Results- In this case, VGG16 and MobileNetV2 outperformed all other models in terms of accuracy, precision, recall. However, the Res-Net50 model showed the worst performance with 85% accuracy.

Drawbacks- The limited availability of data represented a challenge to confidently assess the performance of our models. Open databases of COVID-19 patient records, especially those containing chest X-ray images, are rapidly expanding and should be considered in ongoing future studies (2)

Computer Vision and Radiology for COVID-19 Detection. (3)

The enforced methodology conjointly differentiates the patients plagued by respiratory disorder and COVID-19 as each have equivalent symptoms and patients sometimes got confused between the 2. From this paper, we understood that detecting COVID using X-Ray is much cheaper than the medical COVID-19 test kit and as fast as the current thermal imaging technique. One of the main drawbacks of this research is the lack of data quality. The presently obtainable knowledge assortment is just too restricted to get progressive performance and to switch the thermal imaging technique. We believe that this paper will motivate other researchers to find new methods for detecting potential patients infected with the virus without the explicit use of medical COVID test kits.

(3)Chest X-ray findings monitoring COVID-19 disease course and severity. (4)

CXRs are a good monitor of COVID-19 chest manifestations and their scoring system provides an accurate method to predict the disease severity. Our study also revealed a positive correlation between the patients' age and total severity score to the final disease outcome providing a good indicator for clinicians to identify at an early stage the patients with the highest risk and plan specific treatment strategies for them. (4)

III. METHODOLOGY

Currently, COVID-19 can be detected by PCR tests which take samples using cotton swabs from the nose which makes people uncomfortable. Another way is the RDT test which uses the sample taken from the throat. There are other ways like blood tests which can also be used to detect the COVID-19. We are proposing a method in which we take X-Rays of the thoracic region of a person and we have applied different machine learning techniques to detect whether the person has COVID or Pneumonia. We have used Python language for data analysis which can solve deep learning problems easily. For machine learning projects first step is to gather a dataset. So we have collected dataset from Kaggle, which is a subsidiary of google. The quantity of the dataset plays an important role as more the data the accuracy will be more.

Block Diagram:

Figure 1 shows the block diagram of the project as mention below:

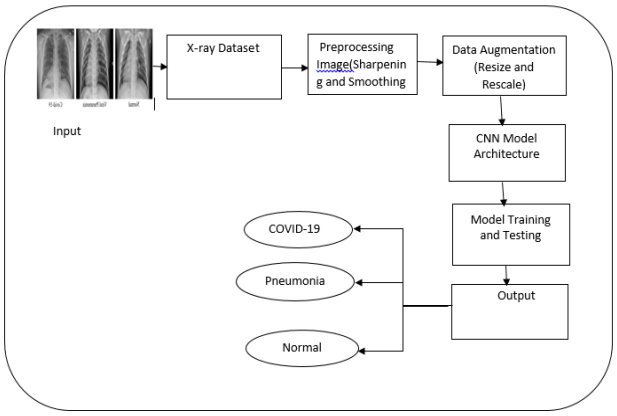

Figure 1. Block diagram

Description of the data set

So we have used 15000 images for our project. From which we have used 12000 for training our model and 3000 for testing the model. Our dataset is divided into three major categories i.e COVID-19, Pneumonia and Normal images as shown in the Figure 2,3 and 4

Here is the sample of each category

Figure 2. X-Ray of COVID-19 affected chest

Figure 3. X-Ray of Pneumonia affected chest

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Figure 4. Normal chest X-Ray

Flow of the project

The process of the project is shown in the Figure 5

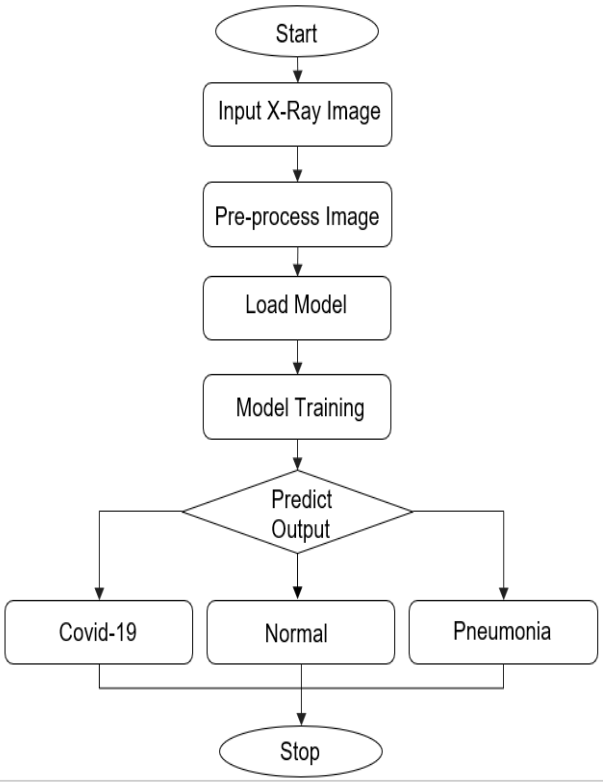

Figure 5. Flowchart of the project

As we know we can't use raw data so we have to preprocess our data before using it. We have used an image data generator for preprocessing.

Image data generator uses image augmentation which is a technique of applying different transformations to original images such as rescaling shear resizing, etc. As there are different images with different pixel values so we have used rescaling to make the pixel values of all images the same. We have also changed the size of images into 224 by 224 as it's a standard size in VGG16 Architecture.

To do these changes we have loaded other libraries such as

- Tensorflow helps us to classify our data, also it allows creating neural networks with many layers
- Numpy is used to construct arrays
- Os is used for creating, removing, fetching and changing data in folders
- Matplotlib is used for plotting graphs
- Cv2 for identifying the images

After preprocessing, we have assigned each category into numbers so it will be easy for our model to take input and give output. We assigned 0 to COVID, 1 to normal and 2 to pneumonia.

Then we load the pre-trained model which is VGG-16. The Architecture of the VGG 16 as shown below in Figure 6:

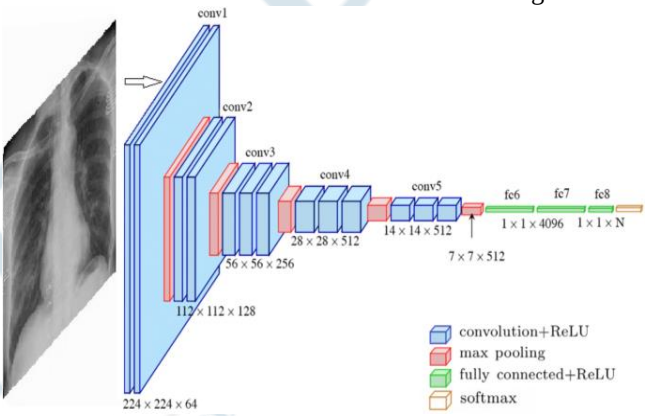

Figure 6. Architecture of VGG 16

VGG-16 is a convolution network architecture. As shown in the image, this architecture contains convolutional layers which are followed by the other layers. The pooling layers are responsible for making the layers more narrow. The 16 in VGG16 depicts the number of layers that have weights. In VGG16 there are thirteen convolutional layers, five Max Pooling layers, and three Dense layers which sum up to 21 layers but it has only sixteen weights layers i.e., learnable parameters layer.

VGG16 takes input tensor size as 224, 244 with 3 RGB channel

The advantage of using VGG-16 is that it doesn't have a large number of hyperparameters instead it have convolution layers of 3x3 filter, max pool layer of 2x2 filter and same padding.

The number of filers in Conv-1 layer, Conv 2- layer, Conv-3 layer is 64, 128, 256 resp. whereas filters in Conv-4 and 5 are 512.

3 fully connected layers follow a stack of convolution layer and soft-max layer is the final layer

Model training –

There are different layers in the architecture of VGG-16 –

Convolution layers - Convolutional layers are the layer where filters are applied to the original image, or to other feature maps in a deep CNN.

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Max pooling layers - It selects the brighter pixels from the image. It is useful when the background of the image is dark.

Dense layers - Dense Layer is used to classify images based on output from convolutional layers.

We have used 2 activations on a dense layer

First is relu (Rectified Linear Unit) activation which is added to layers so that all the negative values are not passed to the next layer.

The Second is the softmax layer which will give an output value between 0 1 or 2 based on the confidence of the model that which class the images belongs to.

The dropout layer is used to fix the over-fitting issue. Input data may have some of the unwanted data as Noise which will be removed by this layer.

Epoch indicates the number of passes of the entire training dataset the machine learning algorithm has completed so we have completed 50 epochs for our model.

IV. RESULTS/CONCLUSION

As cases are increasing day by day, since the spreading rate of covid-19 is very fast, to prevent these a faster detection system is needed. As there are many other methods present nowadays to detect COVID-19, this system is using CXR to detect COVID -19 and also distinguish it from pneumonia very efficiently in a cheaper rate than the medical COVID-19 test kit and as fast as the current thermal imaging technique. So we conclude that this proposed system is time-saving with faster detection of COVID-19 and will also distinguish between Pneumonia.

For the ease of use of professionals we came up with a user friendly interface in which the user just has to put the image in the format jpg, jpeg or png and then it will predict the results as shown in the Figure 7.

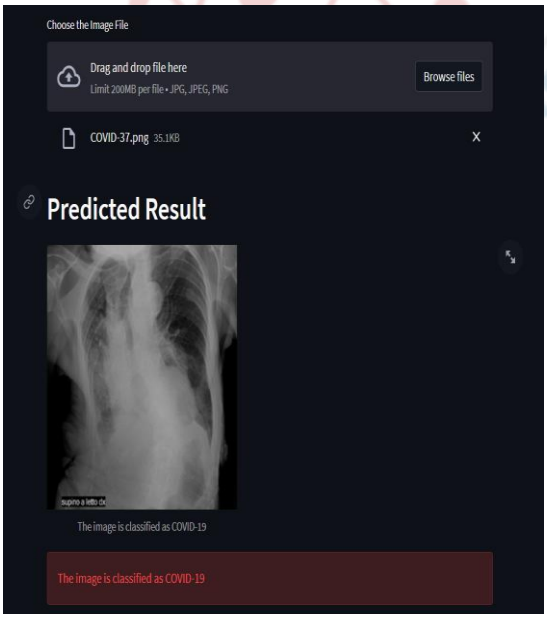

Figure 7. Predicted Result

V. FUTURE SCOPE

We have successfully detected COVID-19, pneumonia and normal scans, and it shows the scope of applying such techniques in the future to alter diagnosing tasks in the future. A massive dataset of chest X-rays is needed to validate our projected model on that. It is also suggested to consult medical professionals for any sensible use case of this project. We tried to develop a perfect detection system but it will more contribute towards the research about possible and economically favorable ways. Such strategies could also be pursued for additional analysis to prove their real case implementation.

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