COVID CLASSIFICATION USING X-RAYS

Submitted to:

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ABSTRACT

The detection of covid using chest X-ray images has life-saving importance for both patients and doctors. In addition , in countries and hospitals which are unable to purchase expensive test kits for detection of covid . this becomes more important. The method used was the keras deep learning using tensorflow. The initial step requires preprocessing the images, then augmentation of images were done, after that we used our custom model by applying our custom layers under the base model of transfer learning model. The layers of transfer learning models were freezed so it would not disturb the custom model, only the weights were used that were trained by xception model and vgg16 model with dataset of imagenet. Through this study our aim is to present the use of deep learning for high-accuracy of COVID-19 detection using chest X-ray images.The dataset is open source which contains X-ray images of (1200 normal and 225 Covid-19) were used in this experiment which involved the training of deep learning model using Transfer learning. The vgg16 and xception models were used as baseline models, it was found that xception model out performs vgg16 in terms of accuracy in unseen data. More than 10 different hyperparameter experiments were performed using convolutional neural networks. A mean accuracy of 93.33 % is achieved.

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INTRODUCTION

During the winters of 2019 , humans faced severe syndrome coronavirus 2 referred to as coronavirus disease 2019 (COVID-19) that enabled people to encounter such disease in the era of technology. In December 2019 COVID-19 outbreaks in the city of WUHAN , CHINA the significant spread of the epidemic in the world. The equipment required to fight with such dangerous disease was insufficient in count.The only way to diagnose such disease is through test kits.

Although rapid COVID-19 tests have a turn-around time, the result is from 3 to 48 hours and not all countries and hospitals can afford such test kits. According to a recently published multinational consensus statement by the Fleischner Society, one of the main recommendations is to use chest radiography for patients with COVID-19 .The financial costs of the laboratory kits used for diagnosis, especially for developing and underdeveloped countries, was a significant issue when fighting the illness. Using X-ray images for the detection of COVID-19 might be helpful for the countries and hospitals which are unable to purchase test kits .This can be significant because no such effective treatment option has been found.

METHODS AND MATERIALS

1. Preprocessing

As we collected the images from different sources so and made different directories for train and test all the X-rays images were in different shape and sizes to handle this problem we resize the images into 224 x 244 pixels, after that we changed the channel of the image into RGB because the XCEPTION model handles RGB image data.After that as we know that normalisation is the most crucial step in pre-processing .This refers to rescaling the pixel values so we normalise the images. To differentiate normal and covid image we used LABELBINARIZER which encodes the normal as (0,1) and covid as (1,0).

2. Augmentation

The quantity of the data was insufficient to overcome this problem and we performed Image Augmentation .We produced each image with a rotation of 15 degrees.

3. Model

The different transfer learning models like VGG16 and XCEPTION were used as base models for our deep learning model. The base model is the head or top of our model. The pre-trained model is used so we can gain the knowledge of the features learned from previous training, in our case transfer model uses the weights which it gained while training the model using imagenet. So when we apply this in our custom model we freeze the top layers and use the previous information gained while training in our custom model.

Our XCEPTION model consists of weights of IMAGENET with the input size of 224 x 244 as we excluded the top layers of the pre-trained model so that it can not affect our model. We applied Average pooling 2D with pool size of 4x4 after that we flatten the

model, implemented the dense layer of 64 neurons and applied the RELU activation function another dense layer is implemented and at this time we applied SOFTMAX with 2 neurons . Before compiling the model we used ADAM optimizer with loss function of binary_crossentropy.

4. Prediction

To do prediction we used the test images directory which consists of two folders namely covid and normal, containing a total of 83 images. To do prediction we need to make the given test data in one dimensional array so it can be in predictable form. Then we applied model.predict inorder to predict the outcome of the image.

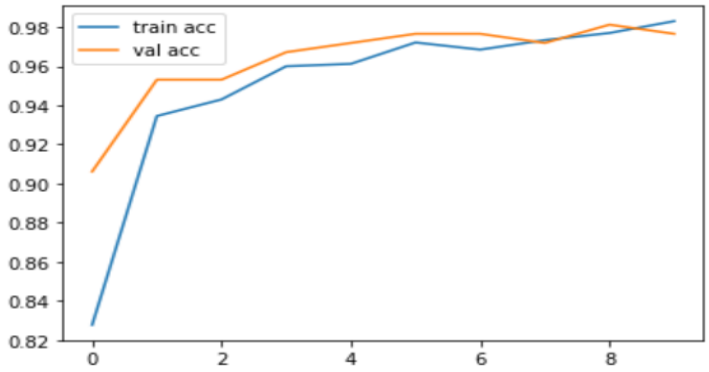
DATA AND RESULTS

Data

A total of 225 COVID-19 chest X-ray images were obtained from github.19 COVID-19 X-ray image collection, and it was created in a limited time. In addition, 1583 normal chest X-ray images were also obtained from kaggle. All images were in different dimensions, so they were resized to 224 X 224.

Results

This section presents the results obtained from transfer learning experiments.



Results of different transfer learning models

We collected the data from different sources because of this all the images comes in different shape and size so pre-processing methods were applied to the images which involves change the size of image which is 224 X 224 then we convert the images in to RGB channel after that we convert the images in to array form and standardize the image matrices. Transfer learning experiments were performed in one group as COVID-19/Normal.

In this group we performed VGG16 produced the worst result whereas XCEPTION produced comparatively better results than VGG16. The accuracy scores of VGG16 and

XCEPTION were calculated as 93% and 97%. Table 1 presents the results obtained using transfer learning for the COVID / NORMAL.

Table 1 : Results Obtain In Transfer Learning Experiments For Covid-19/ Normal

Exp	Mean Sensitivity	Mean Specificity	Mean Accuracy
VGG16	0.6	0.96226	0.85
XCEPTION	0.9	0.9811	**0.95**

The table 1 shows the results of transfer learning using vgg16 and xception model. The sensitivity, specificity and accuracy were taken into consideration. Mean sensitivity is the average of true positive divided by true positive plus false negative, whereas the mean specificity is the true negative divided by true negative plus false positive. The mean accuracy was also calculated. It was found that the mean accuracy obtained by vgg16 was 0.85 whereas the mean accuracy obtained by xception model is 0.95 which is far more accurate. The xception model performed better because it was known that xception model works well with models involving the medical domain. Hence it is proved by our project.

Table 2 TP, FP, TN, and FN results for Exp.XCEPTION

Exp	TP	FP	TN	FN
XCEPTION	52	3	27	1

The table 2 shows the result from our model, 83 images were tested after training the model using xception model as top layer, the true positives given by using xception model are 52 and true negatives given were 27 where as the wrong answers given were only 4, which indicates the importance of using xception model in the medical related

model. Thus, it yields higher accuracy on test data as well when used for medical purposes.

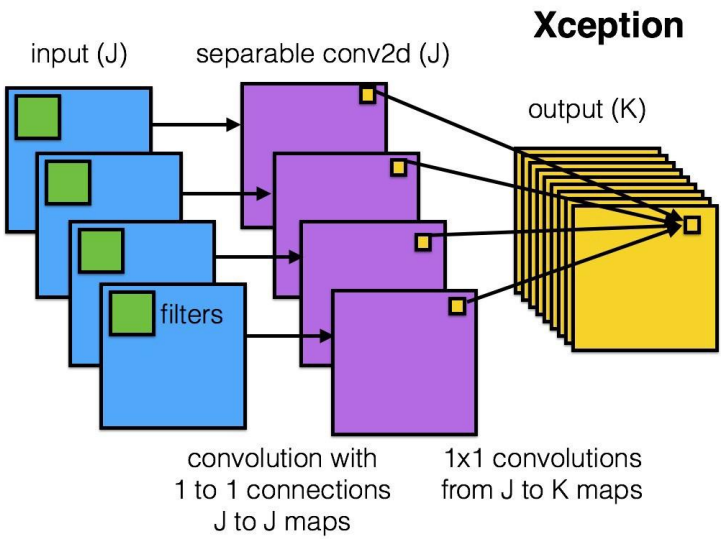


Figure 2. (XCEPTION) architecture with two convolutional and two fully connected layers

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