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COVID 19 detection using chest X-rays

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ABSTRACT

The COVID-19 epidemic is causing a major outbreak in more than 150 countries worldwide, which has a profound impact on the health and well-being of many people worldwide. One of the most important steps in combating COVID-19 is the ability to detect infected patients early, and place them under special care. Diagnosis of radiography and radiology is probably one of the fastest ways to diagnose patients. To accelerate the detection of COVID-19 infections by X-ray images, this study developed a new diagnostic platform using a convolution neural network (CNN) that can assist radiologists with diagnostic detection of COVID-19 pneumonia. Such a tool can save time in translating chest X-rays and increase accuracy and thus improve our medical capacity to detect and diagnose COVID-19. The idea of the study is that a collection of X-ray medical imaging images are used to train CNN which can distinguish between sound and useful information and then use this training to interpret new images by detecting patterns that show certain diseases such as corona infection in individual images. Continue to use transfer learning strategies such as VGG 16, RESNET50, Inception V3 and find out which process provides the best accuracy in obtaining COVID-19.

Keywords: *Corona Virus, COVID-19, CNN, Transfer Learning Models, Chest X-ray Analysis, VGG16, RESNET50, InceptionV3*

1. INTRODUCTION

The Corona virus Disease 2019 (COVID-19) pandemic continues to have an adverse effect on the health and well-being of the human population, caused by the infection of individuals by the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). A crucial step in the fight against COVID-19 is effective screening of affected patients, such that those affected can receive immediate treatment and care, as well as be isolated to stop the spread of the virus. The main screening method used for finding COVID-19 cases is reverse transcriptase-polymerase chain reaction (RT-PCR) testing, which can detect SARS-CoV-2 ribonucleic acid (RNA) from respiratory specimens (collected from a various of means such as nasopharyngeal or oropharyngeal swabs). While PCR testing is the gold standard as it is highly specific, it is a very time-consuming, laborious, and complicated manual process that is in short supply. Evenmore, the sensitivity of PCR testing is highly variable and has not been reported in a clear and consistent manner to date, and initial findings in China shows poor sensitivity. An alternative screening method that has also been utilized for corona virus screening has been radiography examination, where chest radiography imaging like chest X-ray (CXR) or computed tomography (CT) imaging is conducted by radiologists to look for visual indicators associated with corona viral infection. It has been found in early studies that the patient's abnormalities in radiography images that are characteristic of those infected with the corona virus, some suggest that radiography testing could be used as a tool to detect COVID-19 tests in epidemic areas. For example, Huang et al. identified that the majority of the COVID positive cases in their study presented bilateral radiographic abnormalities in chest X-ray images, and Guan et al. identified COVID positive cases in their study presented radiographic abnormalities such as ground-glass opacity, bilateral abnormalities, and interstitial abnormalities in chest X-ray and computed tomography images. Deep learning is the most useful technique of machine learning, which provides successful analysis to study a huge amount of chest x-ray images that can critically impact on screening of Covid-19. Developing a system using convolutional neural network (CNN) to distinguish COVID-19 patients from Non COVID-19 patients based on chest X-ray analysis. This paper, further classified in the different sections such as section 2, discussed various researchers' views in analyzing the impact of the covid-19 disease on countries and humans. Dataset used and model formulation is discussed in section 3. Further, the evaluation of results in terms of training and testing for models used is discussed in section 4. This work is concluded with its future scope in section 5.

2. RELATED WORK

In [1], Alqudah AM, Qazan S, Alqudah A proposed a system for detection of COVID-19 based on Artificial Intelligence. In this, they especially used Machine Learning and Deep Learning Algorithms. They built a convolutional neural network using four different classifiers like softmax, SVM, KNN and RF. All the four gave accuracy around 99%.

In [2], Fu S, Fu X, Song Y, Li M, Pan PH, Tang T, Zhang C, Jiang T, Tan D, Fan X, Sha X took 50 severe COVID-19 patients and divided them into good and poor recovery groups. The dynamic viral shedding and serological characteristics of the COVID-19 viruses were explored. They also explored the risk factors that are associated with the poor recovery and the lung lesion resolutions. Totally fifty eight percent (58%) of the patients had poor recovery. After symptom onset the longest viral shedding was 58 days from the research.

In [3], Ozturk T, Talo M, Yildirim EA, Baloglu UB, Yildirim O, Acharya UR developed a neural network model for both binary classification and multi-class classification. In binary classification they predicted only Covid and Normal chest x-rays. Whereas in multi-class classification they predicted whether the chest x-ray is Normal or Covid or Pneumonic. They used DarkNet model as a classifier for YOLO (You Only Look Once) real time object detection system. They got an accuracy of 98% for binary classification and 87% for multi-class classification.

In [4], Yadav SS, Jadhav SM applied deep convolutional model on chest x-rays to classify pneumonia. They used three techniques for their classification. They are, Linear support vector machine classifier with local rotation and orientation free features; Transfer learning on two convolutional neural network models: Visual Geometry Group i.e., VGG16 and InceptionV3; A capsule network training from scratch. They applied data augmentation as a preprocessing technique and examined the results. They observed that data augmentation gave a good improvement in their analysis and found that transfer learning technique was the effective one from their results.

In [5], Zhao W, Zhong Z, Xie X, Yu Q, Liu J in 2020 took collected 101 cases of COVID-19 pneumonia from four institutions in Hunan, China. They evaluated and compared the basic clinical characteristics and detailed imaging features were between two groups on the basis of their clinical status: nonemergency i.e., mild or common disease and emergency i.e., severe or fatal disease. Patients with confirmed COVID-19 pneumonia have typical imaging features that can be helpful in early screening of highly suspected cases and in evaluation of the severity and extent of disease. Most patients with COVID-19 pneumonia have GGO (ground-glass opacities) or mixed GGO and consolidation and vascular enlargement in the lesion. Their results were among 101 patients, 87 (48 men, 39 women) were in the nonemergency group, and 14 (8 men, 6 women) were in the emergency group. 70.2% of the patients were between 21 to 50 years old.

3. MATERIALS AND METHODS

The dataset used and the methods followed are explained in this section.

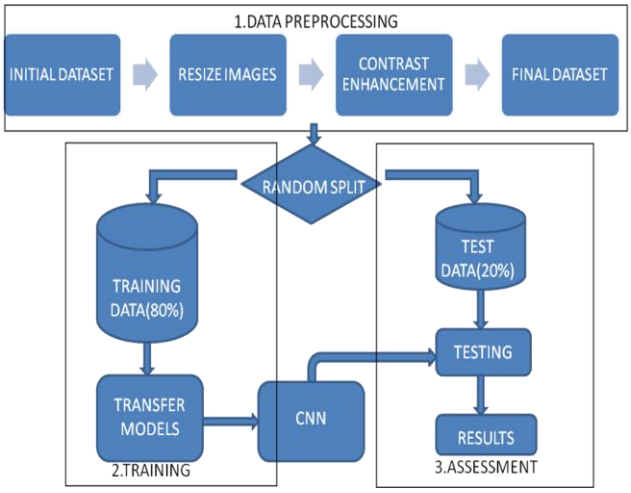

Fig. 1: Flow diagram

3.1 Dataset

In order to detect corona virus using x-ray images we need some sample data (chest x-ray images) which is taken from both normal healthy person and a corona virus affected person. Only then the convolutional neural network can learn from the sample data and effectively find out a corona virus affected person. Our dataset was collected from Kaggle website. The dataset consists of both normal x-ray images and corona virus affected x-ray images.

Table 1: Dataset Distribution

	Train	Test
Healthy Normal Persons X-rays	600	300
Covid-19 Infected Person X-rays	600	300

3.2 Data Preprocessing

Preprocessing the dataset is very important step because if we use the dataset directly we will not get greater accuracy. This step is also called as data cleaning since we remove the unwanted data from the dataset and also we make our dataset suitable for our process. Since we use image dataset we have to perform some of the preprocessing step before feeding our data to the model. The major two preprocessing methods used in our project are,

- Resize Images
- Contrast Enhancement

In our project we have two types of images which is normal x-ray images and covid x-ray images so we have to check for the dimension of those images. The covid x-ray images have a dimension of 256*256 and normal x-ray images have a dimension of 1024*1024. Since there is a difference in the dimensions we have to convert the one having higher dimension image to the one having lower dimension image. Only if both the images have same dimensions the model can figure out the features and differentiate between both the images. So we resize the normal image from 1024*1024 to 256*256.

Adaptive Histogram Equalization covers multiple histograms in each different part of an image, and uses it to distribute light image values, which is why it is different from Histogram Equalization. It is therefore appropriate to enhance the contrast of the area with images. Contrast Limited Adaptive Histogram

Equalization (CLAHE) is a variant of Adaptive Histogram Equalization. CLAHE has one additional step over Adaptive Histogram Equalization and that is clipping of the histogram.

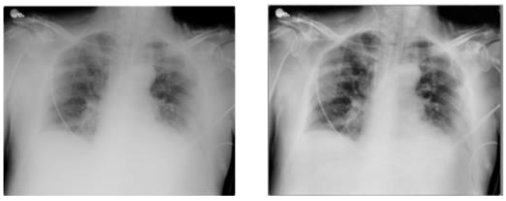

Fig. 2: Covid X-ray before and after applying CLAHE

Fig. 3: Normal X-ray before and after applying CLAHE

3.3 Model Formulation

Transfer learning technique is used for covid-19 detection. We have used 3 transfer learning models. They are,

- VGG16
- RESNET50
- INCEPTIONV3

3.3.1 VGG16: VGG-16 is one of the most popular models for pre-trained model for image processing. Presented at the prestigious ILSVRC 2014 conference, it was a hitting model even today and remained advanced in the Visual Graphics Group at the University of Oxford, VGG-16 hit the AlexNet standard at the time and was quickly adopted by researchers and their field of image classification.The following are the layers of the model:

- Convolutional Layers = 13
- Pooling Layers = 5
- Dense Layers = 3

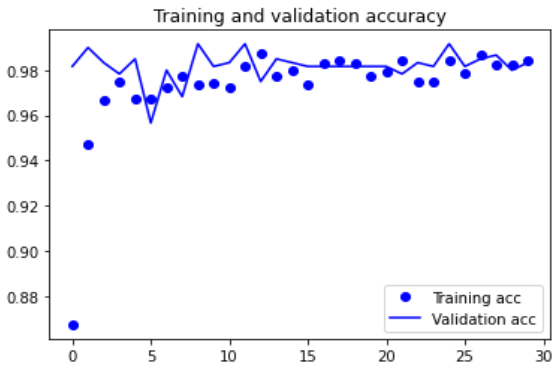

Fig. 4: Accuracy of VGG16

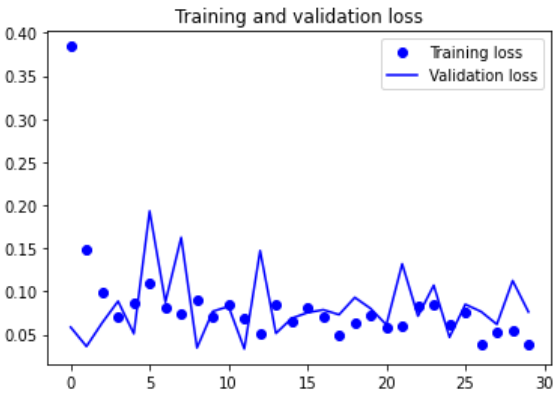

Fig. 5: Loss of VGG16

3.3.2 Resnet50: ResNet, short for Residual Networks is a classic neural network used as a backbone for many computer vision tasks. This model was the winner of the ImageNet challenge in 2015. Great development with ResNet allowed us to train in-depth networks with 150+ layers successfully. Prior to ResNet training very deep neural networks were difficult due to the problem of disappearance of gradients. The following are the layers of the model:

- Convolutional Layers = 48
- MaxPooling Layer = 1
- AveragePooling Layer = 1

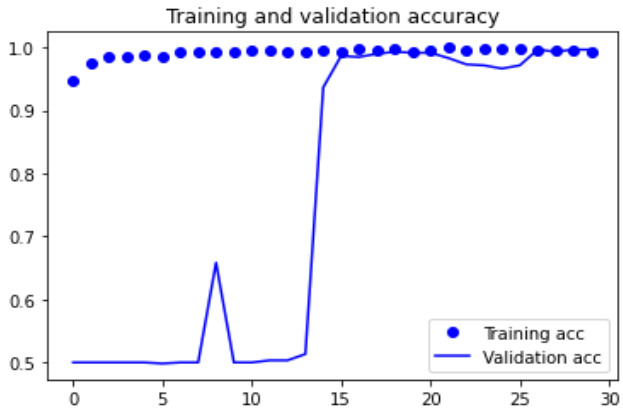

Fig. 6: Accuracy of ResNet50

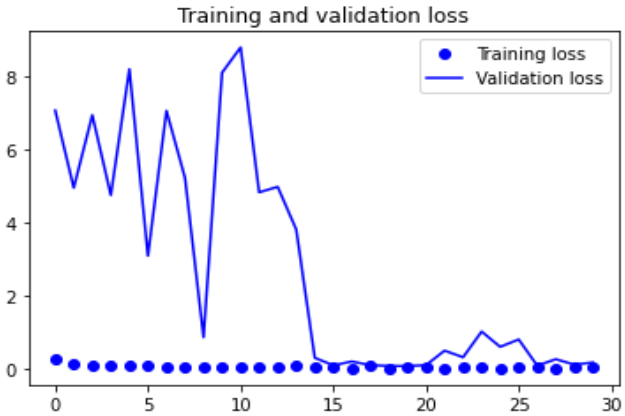

Fig. 7: Loss of ResNet50

3.3.3 Inception V3: Inception v3 is a flexible neural network to aid image analysis and object discovery, and started as a Googlenet module. It is Google's third edition of Google's Inception Convolutional Neural Network, launched earlier during the ImageNet Recognition Challenge. Just as ImageNet can be thought of as a database of segmented visual objects, the startup facilitates the segmentation of objects in the world of computer views. It has 48 layers.

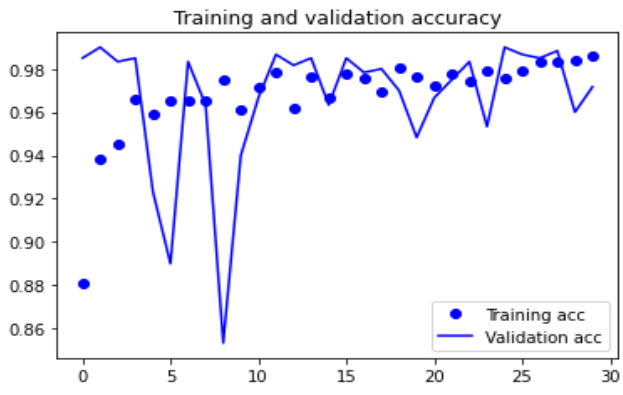

Fig. 8: Accuracy of InceptionV3

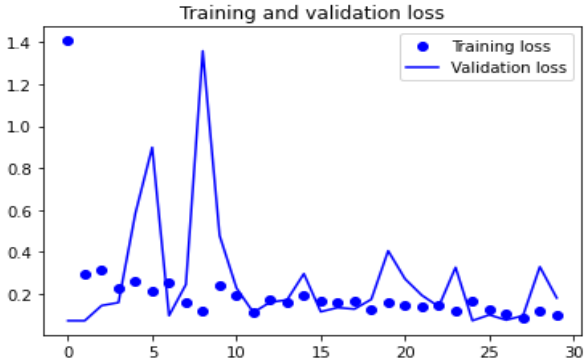

Fig. 9: Loss of InceptionV3

4. CONCLUSION

All the three algorithms works well but when it comes to comparison ResNet50 gives the best result of 99.6%. Even though it gives poor result in the beginning of the epochs the accuracy gradually increases after it learns the characteristics of the image. To conclude ResNet50 is the best among the three transfer learning techniques.

5. REFERENCES

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

[2] Fu S, Fu X, Song Y, Li M, Pan PH, Tang T, Zhang C, Jiang T, Tan D, Fan X, Sha X (2020) Virologic and clinical characteristics for prognosis of severe COVID-19: a retrospective observational study in Wuhan, China. medRxiv

[3] Ozturk T, Talo M, Yildirim EA, Baloglu UB, Yildirim O, Acharya UR (2020) Automated detection of COVID-19 cases using deep neural networks with X-ray images. Comput Biol Med:103792

[4] Yadav SS, Jadhav SM (2019) Deep convolutional neural network based medical image classification for disease diagnosis. J Big Data 6(1):113

[5] Zhao W, Zhong Z, Xie X, Yu Q, Liu J (2020) Relation between chest CT findings and clinical conditions of coronavirus disease (COVID-19) pneumonia: a multicenter study. Am J Roentgenol 1–6.

[6] Asmaa Abbas, Mohammed M. Abdelsamea, Mohamed Medhat Gaber(2020) : Classification of COVID-19 in chest X-ray images using DeTraC deep convolutional neural network.

[7] Arpan Mangal, Surya Kalia, Harish Rajagopal , Krithika Rangarajan , Vinay Namboodiri , Subhashis Banerjee and Chetan Arora(2020) : CovidAID: COVID-19 Detection Using Chest X-Ray

[8] Ali Narin , Ceren Kaya , Ziynet Pamuk(2020) : Automatic Detection of Coronavirus Disease (COVID-19) Using X-ray Images and Deep Convolutional Neural Networks

[9] Terry Gao(2020) : Chest X-ray image analysis and classification for COVID-19 pneumonia detection using DeepCNN.

[10] Maghdid HS, Asaad AT, Ghafoor KZ, Sadiq AS, Khan MK (2020) Diagnosing COVID-19 pneumonia from X-ray and CT images using deep learning and transfer learning algorithms. arXiv preprint arXiv:2004.00038

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