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Deep Learning For Screening Covid-19 Using Chest X-Ray Images

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Abstract: The year 2020 has witnessed the effects of global pandemic outbreak through the unprecedented spread of novel coronavirus COVID-19. As the testing of coronavirus happened manually in the initial stage, the ever-increasing number of COVID-19 cannot be handled efficiently. Also, the coronavirus is divided into 3 phases and it has different effectson lungs. To handle this situation, researchers have attempted to detect coronavirus using chest X-ray images and Chest CTscan images by using Artificial Intelligence[AI] technologies. AI helps to forecast the coronavirus cases for analysing the virus structure and chest X-Ray and CT scan images helps to predict the stags of corona virus. Henceforth, this paper has developed a CNN model, which utilizes 3 classes as follows: positive COVID-19 images, normal images and viral pneumonia images. The model has been trained on these set of images and got 94% of accuracy on training dataset and 96% of accuracy on validation dataset. The proposed model has achieved the test accuracy of 94% for 3 classes in Chest X-Ray image classification. The main motive behind developing this model is to reduce its computational time by using less layers and more hyper parameter tuning. The proposed model is compared with pre-existing models as they were more complexand took much training time. Till now 94% of accuracy has been achieved on test dataset.

Keywords- Convolutional neural networks, COVID-19, neural networks, X-Ray

I. INTRODUCTION

Coronavirus disease (COVID-19) is a newly founded coronavirus-caused infectious disease. It has affected many people around the world. It is basically divided into 3 phases. In very first phase people will feel like they have a fever, or their body will be in fatigue or a dry cough. In second phase they might have loss of taste or smell, a soar throat, diarrhoea, types of skin rashes. In third phase they will have breath shortness, a loss of appetite, a chestpain and they might a fever too. Most individuals infected with the COVID-19 virus will develop mild to moderate respiratory illnessand recover without the need for any special care. Elderly people as well as those with underlying health problems such as chronic respiratory disease, diabetes, and heart disease are diseases that can cause a severe illness. It has affects in different ways to different people .M any people can have mild to moderate illness and they can recover without any treatment. There were many companies those tried to takeout many possible solutions to test coronavirus affected persons but as earliermost of the solution were manual soit took a lot of time to take out the results, around 2-3 days for theresult. Then companies tried to use digital methods to detect the coronavirus. As the number of coronavirus patients are increasing day by day then we need a fast and an efficient method to diagnose a patient and where Artificial Intelligence is the best solution for diagnosis.

The Artificial Intelligence is useful because we can give a set of images together and it will give us more accurate results. Only once we need to train our model on a dataset and then we canuse it for coronavirus classification. Many people across the county have developed many models for coronavirus detection using machine learning and deep leaning algorithms and they have achieved a good accuracy too. But the main focus of my model is to develop a CNN model which is computationally efficient and will give good accuracy on smaller dataset too. As it was difficult earlier to find a dataset of Chest X-Ray images of COVID-19 patients. With the help of this model we would be able to detect the coronavirus even if we have a less number of dataset. CNN is complex and its only weakness is that it needs a lot of dataset fortraining but it is really good for classification.

II. LITERATURE REVIEW

Tulin et al. [3] has developed an automatic model for COVID-19 detection by using Chest X-ay images. Under this model they did two types of classification i.e. Binary classification (contained images of COVID and No-Findings) and Multi-class classification (continued images of COVID, Pneumonia and No-Findings). For study they used a DarkNet

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model as a classifier for "YouOnlyLook Once" (YOLO) which is a real time object detection system.They used 17 layers of convolutional. They achieved 98.08% for binary classification and 87.02% formulti- class classification.

Khan et al. [4] in his paper he proposed a model named "CoroNet,"which is a CNN model for COVID-19 diagnosis using radiography images of chest. The suggested method is based on the "Xception Architecture" which is a pre-trained model with the dataset of Image Net and then it is trained on a dataset that was gathered from various publically accessible databases for research purpose. The average model result rate was 89.6 per cent and the recall and precision rate of COVID-19 cases is as follows: 93 percent and 98.2 percent for 4-classes (normal vs COVID vs. pneumonia bacterial vs. pneumonia viral). For the 3-class classification (COVID vs. Pneumonia vs. normal), classification performance achieved that is 95%.

Alazab et al. [16] in his paper tried to find COVID19 with the help of COVID19 X-Ray images.They used Chest X-Ray images because they are easily available and at a low price. For detection they used 3 Algorithms Short-term Memory Neural Network(LSTM), Auto regressive integrated moving average(ARIMA) model and the prophet algorithm (PA). They were successfully ableto achieve 95- 99% F- Score. They PA gave the best performance overall.For COVID19 confirmation and recoveries they achieved 99.94 of percentage and 90.29 of percentage.

Shelke et al. [12] in her paper she did the classification on chest X-Rays images and designed a classification model which focused on accurate diagnosis of COVID-19. Their dataset contained the chest Xrays images that were divided into 4 classes are as follows tuberculosis (TB), pneumonia, COVID-19 and normal. They used VGG16 model which achieved the precision was 95.9percent.[12]

Narianetal[13] has used 5 pre-trained convolutional neural networks which are based models (Inception- ResNetV2, ResNet50, InceptionV3, ResNet152 and ResNet101) used for detecting the COVID pneumonia infected patient which used chest X-ray Images. They used 3 different binary classifications algorithms byusing 5-fold cross validation with 4 classes as follows (COVID-19,bacterial pneumonia, normal and, viral pneumonia).The ResNet50model gave the best classification performance which is 96.1% ofan accuracy on Dataset-1 and 99.5% of an accuracy on Dataset-2and 99.7% of an accuracyon Dataset-3 in comparison to other 4models.

III. METHODOLOGY

A. Dataset

This research work has used the dataset from Kaggle, which contained chest X-ray images of a normal person and infected person. The database contained the chest X-Ray images of COVID-19 positive cases, Normal chest X-Ray images and Viral Pneumonia chest X-Ray images. Images are in PNG format. The dimension of images is 1024*1024pixels.

Both chest x-rays were originally tested for quality assurance for the review of chest x-ray images, by deleting all low-grade or unreadable scans.Two specialist doctors were the ntested for image diagnosis before being accepted for AI testing. A third expert also reviewed the assessment collection in order to accountfor any scoring errors. The connection to the dataset is availablehere.

FIG 1: Sample Images of COVID19, Normal

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B. Pre-Processing

Inpre processing, the proposed data set is increased by augmentation technique called "Image Data Generator". Image data generator generates more data by applying small changes on itlike brightness, zoom, horizontal flip, shifting etc.Using Image Data Generator which also include pre-processing (like edges harpness, brightness etc.) on COVID Image dataset as its data set was less as compare to other categories in the dataset.

C. Convolutional Neural Network(CNN)Model

A neural network is called a convolutional neural network, designed to handle multi dimensional data such as image and time series data. During the training process, this includes the extractionof features and weight calculation during the training. The identity of such networks is obtained by the use of a convolution operator, which is useful for solving complex tasks.

D. Feature Extraction

CNNs have an automatic feature extraction feature, and that is the key feature. The established source information is usually for warded to the Extraction Network function, and the resultant extracted features will befor warded to the Classifier Network. Various convolutional and pooling layer pairs are used in the process of feature extraction. A series of convolution filters are passed to perform an input data convolution process. As a dimensional reduction layer which defines the threshold, the pooling layer is used. A number of parameters must be changed during back propagation, which in effect minimizes interactions within the framework of the neural network.

Strength–It is most commonly used in deep learning applications with different training methods that offer reasonable results formulti- dimensional data; abstract significant features can be derived from original data.

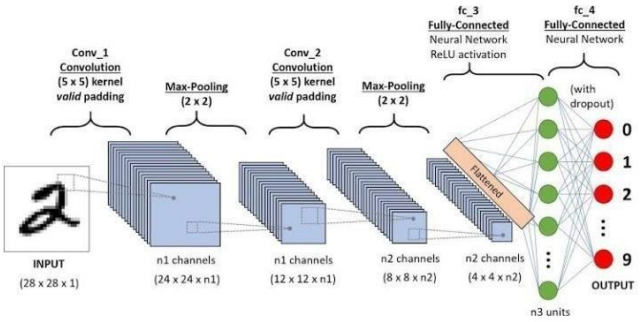

FIG2: Architecture of CNN Model

IV. RESULT AND ANALYSIS

The database contained 3 types of images that are Normal, Viral Pneumonia and COVID19 Positive. I have tried 3 Algorithms as follows CNN, VGG16, and VGG19 formulti-classification of these 3 classes, where all performed well in the classification. The main motive of my algorithm is COVID19 classification. Where we can see the precision for COVID19 is 1.00 and for VGG16 and VGG19 is 0.95 and F1 score and Recall for my CNN model for COVID19 is 1.00 whereas F1 score and Recall for VGG19 and VGG16 issame i.e 0.97 and 1.00 for COVID19.

We can see all three algorithms are giving good results but if we docomparison of Accuracy the VGG16 and VGG19 are giving better accuracy (i.e97%) than my CNN model(i.e 90%). But VGG16 and VGG19 uses more computational powerwhere my CNN model took less computational power in comparison to VGG16 and VGG19.

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Table 3(a): Classification report of CNN model

Actual	Predicted		Total
	Positivepresent	Negative absent	
Positive(68)	TP-58	FP-10	100(90.70%)
Negative(32)	FN-4	TN-28	

Accuracy = (Number of correctly classified images /Total number of images) * 100

Where:
Number of correctly classified images: The count of images that are correctly classified as either normal or COVID-19 cases by the CNN.
Total number of images: The total count of images used for testing, which includes both normal and COVID-19 cases.
Once the CNN has been trained and tested on a labeled dataset of chest X-ray images, the accuracy can be calculated by dividing the number of correctly classified images by the total number of images, and then multiplying by 100 to obtain the percentage. A higher accuracy value indicates a higher percentage of correctly classified images, which reflects the performance of the CNN in accurately screening COVID-19 cases using chest X-ray images.

Sensitivity = Tps/(Tps+Fns) = 93.54%Specificity = Tns/(Tns+Fps) = 73.68%
Positive predictive value or precision = Tps/(Tps+Fps)
= 85.29%

Accuracy = (Tps+Tns)/(Tps+Tns+Fns+Fps) = 86%False positive rate = Fps/(Tns+Fps) = 0.26

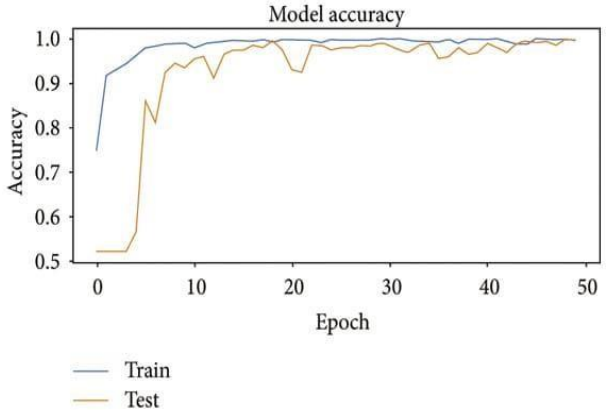

FIG 3: Representation of model accuracy

V. CONCLUSION

The CNN model used for classification has achieved accuracy of about 94% on test data for 3 classes classification, which containsonly 32 images from all categories and its recall and precision ratefor COVID19 are as follows 94 % and 95% , where in VGG16 model has achieved 97% of accuracy and VGG19 has achieved 97% of accuracy for 3 classes classification. The proposed CNNmodel provides good accuracy on less number of layers and less number of epochsin comparison to pre-trained models.

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This CNN model is better than other models as it is less co mplex than others and achieving good accuracy on training, validation as well as on test dataset. As we can see VGG16 and VGG19 are the models which have 16and 19 layerswhere in comparison my model has only 7 layers. If we'll talk about the training time VGG16 and VGG19 are taking too much time to train the model.For now I'm comparing my model on this accuracy i.e. 94%, as I'll modifications on my model to increase the accuracy further for better comparison.

REFERENCES

1. Loey, Mohamed & Smarandache, Florentin & Khalifa, NourEldeen. (2020). Within the Lack of Chest COVID-19 X-ray Dataset: A Novel Detection Model Based on GAN and Deep Transfer Learning. Symmetry.12.651.10.3390/sym12040651.
2. Tulin Ozturk, Muhammed Talo, Eylul Azra Yildirim, Ulas Baran Baloglu, Ozal Yildirim, U.Rajendra Acharya, "Automated detection ofCOVID-19 cases using deep neural networkswith X-ray images", Comput BiolMed. 2020 Jun;121:103792. Published online 2020Apr 28.
3. Asif Iqbal Khan, Junaid Latief Shah, Mohammad MudasirBhat, CoroNet:A deep neural network for detection and diagnosis of COVID-19 from chest x-ray images, Computer Methods and Programs in Biomedicine, Volume 196,2020,105581, ISSN0169-2607.
4. Makris, Antonios & Kontopoulos, Ioannis & Tserpes, Konstantinos. (2020). COVID-19 detection from chest X-Ray images using Deep Learning and Convolutional Neural Networks.
5. PaulMoney,"ChestX-Ray Images(Pneumonia)"https://www.kaggle.com/paulti mothymooney/chest-xray-pneumonia?
6. Rohan Gupta, "6 Deep Learning models- Whenshould you sethem"https://towardsdatascience.com/6- deep-learning-models-10d20afec175.
7. Afshine Amidi and Shervine Amidi,"Recurrent Neural Networks cheatsheet"https://stanford.edu/~shervine/teaching/cs-230/cheatsheet-recurrent-neural-networks.
8. OVID-19 Detection on Chest X-Ray and CT Scan ImagesUsing Multi-image Augmented Deep Learning Model, KiranPurohit, Abhishek Kesarwani, Dakshina Ranjan Kisku, Mamata Dalui,bioRxiv2020.07.15.205567;(https://do i.org/10.1101/2020.07.15.205567)
9. Diagnosing COVID-19 Pneumonia from X- Ray and CT Images using Deep Learning and Transfer Learning Algorithms, author{Halgurd S.Maghdid and Aras T. Asaad andKayhan Zrar Ghafoor and AliSafaa Sadiqand Muhammad Khurram Khan, 2020,(https://arxiv.org/abs/2004.00038).Pla menEduardo, "SARS-COV-2 Ct-Scan Dataset"https://www.kaggle.com/plameneduard o/data
10. Chest X-ray classification using Deeplearning for automated COVID-screening, AnkitaShelke, Madhura Inamdar, VruddhiShah, Amanshu Tiwari, Aafiya Hussain, Talha Chafekar, Ninad Mehendale (doi:https://doi.org/10.1101/2020.06.21.20136598).
11. Automatic Detection of Coronavirus Disease (COVID-19) using X-ray images and Deep CNNs, Ali Narin, Ceren Kaya ,Ziynet Pamuk(arXiv:2003.10849v3)https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question- and-answers-hub/q-adetail/q-coronaviruses#:~:text=symptomshttps://link .springer.com/article/10.1007%2Fs00330- 02006925-3.
12. Loey, Mohamed &Smarandache, Florentin & Khalifa, NourEldeen. (2020). Within the Lack of Chest COVID-19 X-ray Dataset: A Novel Detection Model Based on GAN and Deep Transfer Learning.Symmetry.12.651.10.3390/sym12040651.
13. Tulin Ozturk, Muhammed Talo, Eylul Azra Yildirim, Ulas Baran Baloglu, Ozal Yildirim, U.Rajendra Acharya ,"Automated detection of COVID-19 cases using deep neural networks with X-ray images",Comput BiolMed. 2020Jun;121:103792.Published online 2020 Apr28.
14. AsifIqbal Khan, Junaid Latief Shah, Mohammad Mudasir Bhat, CoroNet:A deep neural network for detection and diagnosis of COVID-19 from chest x-ray images, Computer Methods and Programs in Biomedicine, Volume 196,2020,105581,ISSN0169-2607.
15. Makris, Antonios & Kontopoulos, Ioannis & Tserpes, Konstantinos. (2020). COVID-19 detection from chest X-Ray images using Deep Learning and Convolutional Neural Networks.
16. Paul Money, "ChestX-RayImages (Pneumonia)" https://www.kaggle.com/paultimothymooney/ chest-xray-pneumonia?.
17. Rohan Gupta, "6 Deep Learning models-Whenshould you sethem" https://towardsdatascience.com/6-deep- learning-models-10d20afec175