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COVID-19 AND VIRAL PNEUMONIA DETECTION USING SEQUENTIAL CNN

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ABSTRACT

Coronavirus illness (Covid-19) is expanding over the world and has a history of spreading through communities. The unexpected increase in patients with COVID-19, a novel respiratory virus, has had a significant impact on the healthcare system. There are a limited number of diagnostic kits, hospital beds for such patients, and personal protective equipment (PPE) for healthcare temporary workers, as well as a limited number of ventilators. A deep learning-based prediction system can assist the healthcare system in responding quickly. The crucial significance that chest X-ray pictures can play in the early diagnosis of COVID-19 patients also aids in the treatment of patients at an earlier stage. This paper demonstrates the use of a Convolutional Neural Network (CNN) to extract information from chest X-ray images for illness prediction. Three convolution layers with different filters are used to extract the edges from the photos. To deal with the tiny amount of the training dataset, Keras' Image Data Generator class is utilised to generate augmented images. COVID-19 chest X-ray images, normal persons, and viral pneumonia are used to classify the patients into three groups. The results suggest that the proposed CNN model can accurately predict COVID-19 patients. Modeling the dynamic of COVID19, analysing the efficacy of COVID-19 preventative methods such as travel limitation, and studying the effect of climate on COVID-19 spread are just a few of the studies conducted in relation to the current COVID-19. Artificial intelligence (AI), on the other hand, is a tool for making predictions. The study and development of algorithms (machines) that resemble human intelligence is known as artificial intelligence (AI). Disease identification, therapy selection, patient monitoring, drug development, gene function annotation, automated data gathering, and other applications of AI have gotten a lot of attention.

KEYWORDS*— Convolution Neural Networks (CNN), Transfer Learning, Deep Learning.*

1. INTRODUCTION

The World Health Organization named the coronavirus illness (COVID-19) a pandemic on March 11, 2020. (WHO). It is a viral infection that causes respiratory sickness in the majority of patients and is thought to have originated in Wuhan, Hubei Province, China [1, 2]. Coronavirus disease is caused by a single coronavirus that was previously known as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [3].

The Reverse Transcription- Polymerase Chain Reaction test is utilised as a standard diagnostic method to detect viral nucleic acid as coronavirus infection in Severe Acute Respiratory Syndrome Corona Virus 2(SARS-CoV-2)suspects (RT-PCR). The RT-PCR test can take anything from 4-6 hours to an entire day. The RT-PCR test has a number of drawbacks, including a longer time to generate findings and the possbility of false positive and false negative results. Due to the high false-negative rate of RTPCR tests and their high cost, it is difficult to offer enough RT-PCR test kits for testing in many afflicted regions and nations. Therefore, to address these are an issue so Chest x-ray is that the commonest methodology of examining common metabolic process and respiratory organ infection for quick and efficient identification. Varied analysis teams to detect COVID-19 by the radiographic images of patients recently experiment with chest x-ray imaging. COVID-19 detection from chest x-ray rules out the prospect of the

doctor obtaining infected by the COVID-19 patients. The most significant obstacle is the resemblance between COVID-19 and pneumonia [4], which is caused by different diseases. COVID-19 cases are distinguished from normal and pneumonia cases using the Convolutional Neural Network (CNN) classifier in this study.
The paper is "COVID-19 Detection" [8]. Here two model are used that are ResNet-50, VGG-16 and this paper also describe a CNN model for the detection of COVID-19 by use of multiple image dataset in this it takes the suspects of CT scan and suspect of chest x-rays of the individuals. For feature extraction, the proposed model does not need anything. This model gives the highest accuracy for the CT scan images that is approximately 95.39% and the accuracy for the X-ray images is about 98.98%.

2. LITERATURE SURVEY

In the paper, "CovidAID" [3] the authors worked on the chest X-ray which helpful for the system to make out the decision that whether the patient would be live with the other patient or isolate within a ward and that also helpful for the false-negative RT-PCR. In this model, CheXNet is used with an accurate measure of 90.6% with 100% recall for covid-19 detection.

In the paper "COVID-19 Screening" [5] the authors worked on the X-ray images because the CT scan images are not much enough to provide good results so the X-rays were used to detect the impact of covid-19 of an individual patient, here 18 layers of residual convolution layer are used pre-trained on the ImageNet dataset. In the training phase, that will produce a sensitivity rate of 90% and specificity of 87.84% with the X-ray dataset. However, the limitation is that it missing approximately 4% of corona cases and about 30% in the error in positive rate.

In paper "Automatic Detection of Coronavirus Disease" [6], different classification models, such as ResNet50, ResNet101, ResNet152, and InceptionV3, are used to detect COVID-19 in chest X-ray images that belong to one of three groups. The learning approach was used instead of ImageNet because ImageNet requires too much data and training time. From all the above classifier the ResNet50 and ResNet101 have an overall output of 96.2% with nearly 99% to detect the Covid-19. The highest accuracy for the three different datasets for the Covid-19 detection is for Dataset 1: accuracy is 96%, Dataset 2: accuracy is 99.5%, and for Dataset 3: accuracy is 99.7%.

In paper "Transfer Learning with Deep Convolutional Neural Network for Pneumonia Detection" [7], MATLAB was used in training and examine the model, in these image sets are going through some pre-processing steps. Pre-trained algorithms like AlexNet, ResNet18, DenseNet201 and SqueezetNet do Dataset Augmentation and training. From the above all, the pre-trained algorithm the highest accuracy is given by DenseNet201 95%.

In paper "COVID-19 Detection" [8], two model are used, ResNet-50 and VGG-16 and describes a CNN model for the detection of COVID-19 by use of multiple image dataset in this it takes the suspects of CT scan and suspect of chest x-rays of the individuals. For feature extraction, the proposed model does not need anything. This model gives the highest accuracy for the CT scan images that is approximately 95.39% and the accuracy for the X-ray images is about 98.98%.

3. PROBLEM STATEMENT

Coronavirus disease (COVID-19) is an infection caused by a newly discovered coronavirus that causes symptoms over a seven-day period. As a result, it necessitates a precise diagnosis at a precise time. There are a limited number of diagnostic kits, hospital beds for such patients, and personal protective equipment (PPE) for healthcare temporary workers, as well as a limited number of ventilators. To make the most use of the limited resources at our disposal, it's crucial to determine whether people with severe acute respiratory illness (SARI) are infected with COVID-19.

4. PROPOSED SOLUTION

In this study, we used a model of deep learning for predicting the status of Coronavirus in the chest X-ray images of the patients. The model is created on a convolutional neural network (CNN). For image recognition [8] convolutional neural network (CNN) a class of deep neural networks is used. In CNN the input image is converted into a format that can be processed by the computer. Because of that reason, images are firstly converted to matrix format. The system then uses the differences in photos to decide which image belongs to which group. The model learns these differences on the label during the training phase. Then trained model makes predictions for input images.

To achieve the analytic technique of COVID-19 virus, the model has three basic phases, which are as follows:
Step 1: Pre-processing All chest X-ray images are stored in one dataset (dataset is available on Kaggle [7]) and provided for rescaling at a same size of 256 X 256 pixels to be appropriate for feature extraction.
Step 2: Training the Model and Validation To start the this phase of proposed deep learning models, according to the Pareto principle the pre-processed dataset is split in the ratio of 80-20. It means 20% of X-ray images are used for testing purpose. And, 80% chest X-ray images are used for training the model.
Step 3: Classification At the end of the model, the testing images is served to the given deep learning based classifier to classify all the chest X-ray image batches into one of three classes: positive viral pneumonia, normal case or COVID-19. In the end, to analyse the overall performance of the model various performance matrices was calculated based on the following metrics described.

5. CONCLUSION AND FUTURE SCOPE

There are many methods to detect Coronavirus in patients but deep learning-based systems are very common in this pandemic. Large number of research is done on COVID-19 detection; some of these are given in related work. For two classes, the main goal is to differentiate between COVID-19 negative cases from COVID-19 positive cases. For three classes it is very hard to differentiate between viral pneumonia and COVID-19 patients. Viral pneumonia is another type of diseases infecting the lungs of the patient. Arpan Mangal [1] did the research for three types of classes (Normal, Viral Pneumonia and COVID-19) and obtained 90.6% accuracy with 100% sensitivity (recall) for the COVID-19 infection. Jianpeng Zhang [2] conducted studies and obtained a 90.00% sensitivity and 87.84% specificity. In this study, the dataset contains 70 X-ray images of COVID-19 infected patients and 1008 X-ray images of viral pneumonia infected patients. In this study, we have obtained an overall 96% accuracy with 3829 X-ray images. For the COVID-19 class, our proposed model achieves 99% precision with 97% sensitivity (recall). It shows our model is better than Arpan Mangal and Jianpeng Zhang studies. The performances of our model in the COVID-19 class is significantly higher than the other two classes (normal and viral pneumonia). In this study, we have used more chest X-ray images than many studies. Finally, we have proposed a deep learning network that will identify the normal, COVID-19 and viral pneumonia patients with an accuracy of 96%. This model is trained on 3034 images and at the same time tested on 765 images where 255 images belong to each class. In the end, we are validating our model on 30 images. This network is useful for detecting COVID-19 at an early stage.

In future, we want to add some more images to our dataset to improve accuracy. In future we will integrate this model to Android application. We will also compare different architectures of CNN on different datasets: LeNet,AlexNet, ZFNet, GoogleNet, RestNet. In future, we are also planning to work upon various existing and unfortunately upcoming variants of COVID-19 like delta variant and omicron to make our project more valuable. We are willing to make our model give more precise predictions about the various variants of the COVID-19 virus.

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