Screening of Covid-19 using Chest X-Ray Images

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***Abstract*—Coronavirus disease (COVID-19) caused by SARS-CoV-2 virus which is an infectious and communicable disease. This disease spreads rapidly in a short duration of time. There are two ways of detecting this virus they are RT-PCR and Chest X-rays. Due to disadvantages associated with RT-PCR testing the new trend is moving towards analyzing chest scan images. Advantages of chest X-ray images are- It is faster than RT-PCR and it can deal with mutations that occurs in virus. Based on this we have done literature survey of 10 papers. Our project uses chest x-ray images of lungs of patients where machine learning and image recognition programs will help us to detect whether a patient is infected with covid-19 or not. The outcome of literature survey gave a fair idea about different models which helps in detection of covid-19 and their associated accuracy. We got to know about various data augmenting techniques, use of bio-indicators, Inception-v3 and CNN models.**

Keywords—GAN, Covid-GATNET, Inception architecture, SV3 Algorithm, Covid-STACKNET, U-NET.

I. INTRODUCTION

After ten years of influenza, H1N1 virus pandemic the world is now witnessing an even more gigantic pandemic called the "The coronavirus disease-2019" (COVID-19). In December 2019, covid-19 which is a global pandemic was discovered in Wuhan, China in December 2019. This is the seventh coronavirus (COV) to be identified in humans. As COVID-19 is a communicable disease it spreads faster in the situation where people are in close proximity. Therefore, travel restrictions are imposed to confine the virus which in turn helps to reduce the number of cases. Regularly cleaning hands with sanitizers or with soap and water; maintaining at least 3 feet distance from others and avoiding crowded places are some of the precautions which can be taken. Meanwhile, the most common infection symptoms are headache, cough and fever. Other symptoms are chest discomfort, sputum development and a sore throat. COVID-19 can easily convert into viral pneumonia that has death risk of about 5.8%. COVID-19 Mortality rate is quite high and keeps on getting mutated during different phases.

The virus has the ability to freely transmit from an infected person's mouth or nasal fluid in the form of little droplets when they speak, cough and sneeze. Respiratory secretions or droplets expelled by infected individuals contaminate the surface. Reverse transcription-polymerase chain reaction (RT-PCR) is the standard diagnostic technique method and rapid antigen tests (RAT) which tells us the information about current infection. An antibody test tells us about the past infection. Most of the people who get infected have very few symptoms or are usually asymptomatic and recover gradually. But 15 to 20% of people usually develop severe symptoms and may need hospitalization, ICUs and other medical facilities.

COVID-19 diagnosis in the initial stage with greater accuracy viral RNA is recommended through RT-PCR. But certain studies now have found out that CT scans and X-rays have been more effective as it is less time consuming and helps in early detection and isolation of the infected people COVID-19 currently has no specific treatment therefore care and prevention is of utmost importance. For this pandemic test, track, treat is the main solution to prevent the spread of infection so this can be detected by utilizing image analysis techniques and machine learning techniques.

COVID-19 signs in the lower part of the lungs can be detected with greater accuracy by taking help of X-rays instead of using RT-PCR. During emergency conditions where the test report is required within a short span of time these tests play a vital role. However, it has yet not been proved to be completely effective at all times. In order to overcome this, speed and reliability of this process needs to improve. By using Artificial Intelligence (AI) based model detection becomes easier, cheaper and faster. The main goal is to cut down the detection time taken and also the usage of so many kits, storing these samples makes it tedious. By using CT scans and X-rays detection becomes easier and it can be stopped from spreading at a faster pace.

With the passage of time, machine learning (ML) is being used in almost every field. ML is used in malware detection, medical diagnosis and healthcare, social networking, banking, etc. A new Machine Learning system named Deep-learning was invented, which uses the concept of convolutional neural network (CNN). Deep learning is also an important concept used in ImageNet classification, which is the globe's ultimate competition on computer-vision. Computation of several layers can be done using deep learning algorithms to learn data representation via many abstraction layers. Classification of pictures, sounds and text can be done through a deep learning model. In certain instances, deep learning models improve human output. This COVID-19 pandemic is a big lesson in which more systematic approaches are needed in order to prepare in advance for other emerging viruses or any future pandemics.

II. LITERATURE REVIEW

Mohamed Berrimi et.al [1] proposed that chest imaging is vital in detection of COVID-19. The severe symptoms appear in age old people and patients with chronic illness. Research reveals that CT imaging and Chest X-ray are more reliable and practical especially for the people in the age group of 21-50. Convolution Neural network works for large scale datasets so in order to overcome this we use Transfer learning. This paper uses three major steps which are data augmentation, training model DenseNet convolution network and second trained model DenseNet convolution network is applied on augmented dataset. They use the method of training the models using Dense Net and InceptionV3.The developed approach outperformed the other models. This paper shows the reliability and effectiveness of the model.

Oishy Saha et.al [2] proposed an ensembling approach where multiple convolution neural networks are used. The different methods used are feature concatenation and decision fusion approach. Feature concatenation obtain features from the base models and aggregate and send it to the classification header. Further in decision fusion approach multiple predictions are made into a single prediction by highest voting method. In this paper three class and four class classification is done. Three class classification gives 96% accuracy and four class classification gives 89.21%. So better performance can be obtained by using some efficient models together. Both the approaches help in the better classification of the image.

Mohit Mishra et.al [3] gave a model for classification of covid 19 from other lung ailments. Four classes taken are Covid-19 pneumonic, Non Covid-19 pneumonic, having pneumonia and normal lungs. This model consists of two stages in which the first stage image is classified into 2 different categories. One category is normal and the other category is pneumonic patients. In the second stage pneumonia is further classified into covid and non – covid patients. 2D CNN is given a name CovAI-Net is utilized for classification of potential Covid-19 patients with help of their chest X-ray image. When tested on X-ray volumes we got accuracy for stage one classification as 96.5% and for stage two classification as 98.31%.

Sohaib Asif et.al [4] This paper provides a method to find COVID-19 pneumonia patients with the help of chest x-ray images which increases the accuracy in detection with the help of deep convolutional neural networks. Detection of coronavirus and pneumonia with help of chest X-ray images can be utilized using transfer learning with DCNN based model Inception V3. Transfer learning is a ml technique which is based on the idea of reusability. The model gives an accuracy of 98% (training accuracy of 97% and validation accuracy of 93%).

Mohammed Abdul Azeem Siddiqui et.al [5] gave a method for detection of covid19 with the help of a variety's bio indicator with main interest in lung imaging. various biomarkers for diagnosing COVID19, as these images can be effortlessly taken from medical diagnosing methods like CT scans and Ultrasound. The following four Bio indicators are considered mainly are: 1) RiboNucleic acid, 2) Virus or Antigen, 3) Antibody (IgG), 4) Lungs The model gave sensitivity of 100% when X-ray images are used and sensitivity of 90% when CT images are used and 94% accuracy total.

Prerak Mann et.al [6] proposed a method for generating artificial X-ray images of chest which includes both positive and negative covid patients. They also mentioned that generating images can be done by utilizing the GAN (Generative Adversarial Network) model. Images need to be preprocessed before sending it to the GAN model. So, some preprocessing techniques should be done on images like fixing the size of image, making images brighter and so on. Pytorch vision library resize images to 224 x 224 and normalize image pixels to [-1,1] from [0,255]. Generator and Discriminator are the two primary networks of the GAN model. The noise vector of 100 x 1 is given has input to the generator and that outputs a single image. This layers output is given as input to five transpose convolution layers. The discriminator model identifies the image are fake or real. On an average, 40% of generated images are predicted properly. Images are generated for the purpose of training CNN (Convolution Neural Network) based predictive model which gives more accurate and better results.

Junfeng Li et.al [7] gave a model called COVID-GATNet which helps in automatically diagnosing CXR images, so that detection can be done quickly. This study involves three chest X-Ray images of healthy persons, pneumonia and COVID-19 patients. To expand original data geometric transformation operations are used. COVID-GATNet model is developed by combining two network models i.e Densenet Convolutional Neural Network (DenseNet) and Graph Attention Network (GAT). This model links between layers and utilize the attention mechanism for processing data. The accuracy of the model is done through the confusion matrix and further tests of predicting positive have been calculated by using three types of chest X-ray images. The accuracy of COVID-GATNet is 94.1% and this is compared with COVID-Net model having accuracy is 93.3%. This COVID-GATNet model is more accurate and efficient.

Mohammed Ridouani et.al [8] proposed a new model which follows StackNet meta-modeling, CNN and Ensemble Learning. The name given to the model is Covstacknet. All these models help in feature extraction from X-Ray images. Ground glass opacities (GGO) is the type of pattern which is most common in covid-19 patients. Based on this idea they thought of using X-ray images for diagnosis purpose. The purpose of using Stacknets is a model where this, increase the

accuracy and to reduce the training errors of the model. The VGG16 model is used to extract features which cannot be seen in the original images. Two models are trained, the first model is used distinguish between normal images from pneumonia infection. If the image is normal the model stops its executions and gives the output has normal image. If the image belongs to pneumonia model 2 will be encountered where this model helps to distinguish between covid and non-covid. The accuracy of model 1 is 97% and model 2 is 98%.

Ali Narin [9] proposed a Convolution neural network model has 3 datasets – normal, covid-19 and viral pneumonia. s. CNN consists of many layers like pooling layers and fully connected dense layers. Convolution and pooling layers help in extraction of features maps from images and with the help of fully connected layers classification process will always takes place at the end neural network model. To get more accurate and more stable result 5-fold cross validation method has been used. The data is pre-processed using matlab2020 the it is given to CNN model then to SVM. SVM model classifies the given data and base on that it will give output. This model is more accurate because it will give very high results even for a limited number of Covid-19 data.

Zhaohui Liang et.al [10] proposed a best working model. The available dataset is very less, to solve this problem synthetic images has to be generated to train model to acquire better results. cGAN model is been used to perform translation or conversion from non-covid-19 chest x-ray images to covid-19 chest x-ray images. Even U-Net based architecture model helps to generate synthesized COVID-19 X-Ray chest images from the normal chest X-ray images. The main aim of the paper to translate images so that the available dataset can be increased hence accuracy of the model can be increased. The model accuracy has been achieved is about 97.8%.

III. PROPOSED METHODOLOGY

After going through above papers and their different methodologies, we thought that machine learning and image processing techniques are most suitable to build a diagnosing covid model. The below figure 1 is the flow chart of our model. Here for the purpose of diagnosing we are taking the Xray images. Using Kaggle website we are collecting the images of four classifications- Covid-19, pneumonia, non-pneumonia and normal person images.

These images will be pre-processed before using. The images will rescale, shear, zoom, flip etc. After this process, the images are sent through various layers of convolution model. Based on this model will be trained using a set of training data and based on validation set the model will be tested. In our model 1st we are going to distinguish between covid positive and covid negative. Based on above result the images will be sent to 2nd model to distinguish between pneumonic and non-pneumonic. Below figure 2 shows about two model. Now whenever we need to test the patient X-ray images, then for the above trained model we have to send the X-ray images. Based on previous learnt knowledge model will diagnose the image. Because of using two model we will get two different accuracies.

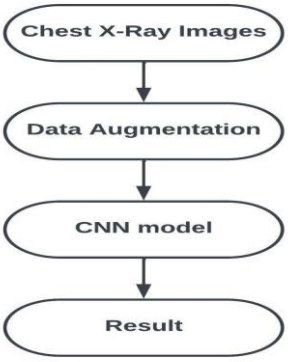

Figure 1: Proposed Work flow

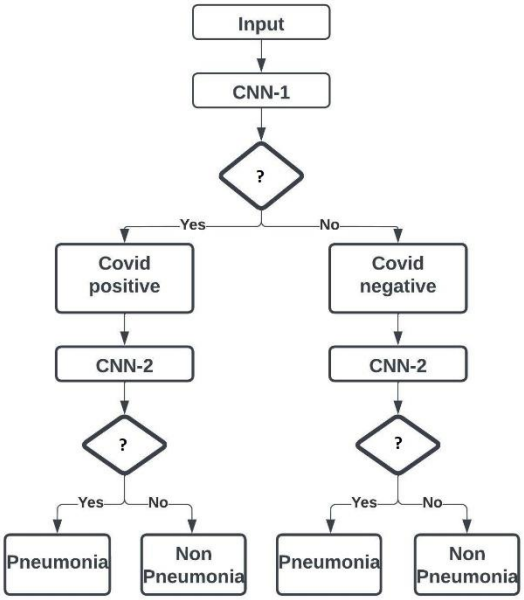

Figure 2: Detailed process of Classification

IV. OUTCOME

TABLE 1: Outcome

Papers	Outcome
Oishy Saha et.al [2]	In our model decision fusion idea is used, the majority voting class that we get from the predictions of the models is considered as the final class.
Sanhita Basu et.al [11]	Convolutional neural networks (CNNs) idea is used in our model
Mundher Mohammed Taresh et.al [12]	VGG16 is the best among various models in COVID-19 treatment with following results sensitivity, F1 score, precision, specificity, and accuracy Deep learning has vital role in differentiating between 2 types of pneumonia, that is viral and bacterial pneumonia
Mohamed Berrimi et.al [1]	Data Augmentation-enhance the number and diversity of the chest scans Preprocessing – reshaping total images with a constant size - 256 × 256 pixels.

V. CONCLUSION

The outcome of the literature survey gave a fair idea about different models which helps in detection of COVID-19 and their associated accuracy. We got to know about various data augmentation techniques, use of bioindicators, Inception-v3 and CNN models. ML-based techniques are utilized for the COVID-19 detection which is one of the quickest methods. This will help in saving life's of patients by instant accurate results which helps doctors to provide treatment quickly. Enhanced surveillance, proper research about the infectants ensures better public health in the future. Prevention is also better than cure so early detection helps in easy tracking, treatment. The AI techniques are helpful even if mutations occur and the price of the tests will become much cheaper on effective implementation of the above models.

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