Detecting CORONA VIRUS Using chest X-ray image

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ABSTRACT

Corona Virus continues to possess its effects on people's lives across the world. The screening of infected persons is a vital step because it is fast and low-cost way. Chest X-ray images play a major crucial role and it is used for examination in the detection of CORONA VIRUS(COVID-19). Here radiological chest X-rays are easily available with low cost only [1]. In this paper, we are using a Convolutional Neural Network(CNN)[2] based solution that will benefit in detection of the Covid-19 Positive patients using radiography chest X- Ray images. To test the efficiency of the solution, we are using public available X-Ray images of Corona Virus-Positive cases and negative cases. Images of Positive Corona Virus patients and pictures of healthy person images are divided into testing images and trainable images. The solution which we are providing will give good results in classification accuracy within the test set-up. Here we are going to develop a GUI application for medical Examination areas. This GUI application can be used on any computer and performed by any medical examiner or technician to determine Corona Virus positive patients using radiography X- ray images. The result will be shown or provided by this application is really fast and done within a few seconds.

Keyword : - *Deep Learning, CNN, Convolutional neural networks, Detection.*

I. INTRODUCTION

COVID-19 is an infectious and fast spreading deadly virus and it was spreading all over the globe. The World Health Organization declared COVID-19 as a pandemic disease on March 11th 2020[2].The announcement of the pandemic also starts the panic of the increasing the spread of CORONA VIRUS. It is illustrated as a global safety emergency of its time and it has spread everywhere across all different countries. Government of varied nations are imposed different limitations and restrictions such as flight limitations, lockdown, social distancing and spreading awareness of the consciousness about cleanliness [3]. But the Virus was spread at a high speed all over the world. For the infected people, the virus was directly attacked on the lungs. There are some assumptions that old or elder people with other diseases such as diabetes, Blood pressure etc., will be infected easily and it may affect their health deeply[5]. In early stages, there is no correct and proper medical diagnosis for COVID-19. About 78,115,053 positive cases are found across all countries in the world until 24th DEC 2020,where 1,717,640 deaths and 54,890,244 recovered cases were found.

In order to prevent this virus, the sick patient has to be screened with proper medical diagnosis. At early stages the detection was done by testing kits manually using a technique called Reverse Transcription Polymerase Chain

Response (RT- PCR) test on respiratory tracts [4]. The procedure which was used earlier was used to detect the disease. However, the testing method was manual, complicated, lack of equipment, and time-taking procedure with a normal positive success rate [6].

The symptoms of the COVID-19 virus are having emphysema causing fever, whooping cough and breathing failure [2]. Most of the CORONA VIRUS cases have identical similar spots on radiography chest X- ray photographs, those identical spots can be easily identified by comparing with other positive patient cases. Even though normal lungs X-ray images may serve early broadcast of infected cases, the X-rays of differing viral cases of pneumonia are comparably which may protrude with various other contagious and erythrogenic [4]. Hence, it is hard for radiologist to identify corona virus from other different types of virus. The complications of coronavirus is like viral infection and it can sometimes cause an incorrect separate within the current conditions [3]. Hence, a wrong treatment can cause a non-corona viral infection is wrongly decided as supportable of getting CORONA VIRUS and during this process, giving in treatment with high price, and risk of implementing a positive CORONA VIRUS patient. Presenting, a lot of medical difficulties like brain disease detection, any many other detection, are using Artificial Intelligence (AI) based solutions. For image classification we are using Deep Learning techniques therefore it can reveal images with high quality [7].

In Convolutional Neural Network has been displayed incredibly useful in learning and extraction, thus widely considered and approved by many research persons and groups. Convolutional Neural Network is used to increase image quality in dim light images from a very speed endoscopic and was put in to differentiate the thought of respiratory lungs through images, the finale of pneumonia by means of chest X-ray images [1]. According to Vikash, transfer learning concept in Deep Learning was used for the detection of pathology utilizing trained ImageNet designs [5]. Due to panic situation the testing of CORONA VIRUS testing is present a tough task due to the unfeasible of the diagnosis system. Due to the less hereness of CORONA VIRUS testing kits, we need to look upon various diagnosis procedures. Since CORONA VIRUS present on the cells called epithelial cells that presents on the lungs. We are going to use X-rays images to find the presence of cells on a infected lungs.

The examiners are using radiography X-ray images to research pneumonia and many other lung related diseases. In this present world many hospitals having their own Radiography X-ray imagining machines. So, we can check patient X-ray images instead of using testing kits, whether it is infected with COVID-19 or not. Here a drawback is that a radiography examiner can't able to diagnose many patient X-ray images very fast and correctly [8]. Hence, developing an automated analysis application will save medical field persons precious time. Today, many are describing deep-learning techniques are the best for the image classification [6].

II. RELATED WORKS

The process of identifying and detecting COVID virus has become more importance all-around the world for some months. Covid virus has taken the first place for spreading so fast that has become hard to control .Covid has become so hard for detecting as the person are not showing symptoms immediately. Thus it is more important to find new methods to differentiate the covid positive people with normal people to eliminate the possibility. Artificial Learning can be used to examine a person for COVID-19 as an alternative to traditional time-consuming and expensive methods [4]. Even'tho there are many papers on covid virus ,this paper is focused on detecting covid virus using Artificial Learning classification techniques using X-ray pictures and predict the people is positive to covid virus or not. Several research areas have implemented Artificial Intelligence. One of the most advantages of AI is that they are often implemented during a trained model to classify unseen images [3]. In this study, Artificial Intelligence was used to detect whether a patient is positive for covid-virus by analysing their lungs X-ray pictures [3]. Artificial intelligence can also be used to predict the status of person like he is positive to covid or not by using existing evidence. Thus, predicting possibilities within the immediate future can help authorities to adopt the required measures. Wynants et al. mainly stressed on 2 important concepts: the first concept is to get idea of

techniques that are used to diagnosis the covid –virus and the second concept is to forecast the number of cases that can come in upcoming days. The paper also suggests that existing models are delicate and unpredictable.COVID-19 Diagnosis Using Deep Learning, the advantages of Machine Learning are increasing quickly in various fields such as malware detection, mobile malware detection, medicine, and knowledge retrieval. Deep-learning algorithms enable computational models composed of multiple processing layers to find out data representation through several abstraction layers. They trained a computer model to perform classification tasks directly from pictures. According to LeCun et al., deep- learning models feature high accuracies and may improve human output in certain instances.

X-Ray Diagnosis Using Deep Learning

X- ray machines use light or radio waves as radiation to look at the affected parts of the body due to cancers, lung diseases, bone dislocations, and injuries [2]. Meanwhile, CT scans are used as sophisticated X-ray machines to look at the soft structures of active body parts for better views of the particular soft tissues and organs. The advantages of using X-rays over CT scans are that X-rays are quicker, safer, simpler, and less harmful than CT scans. Narin et al proposed a Convolutional Neural Network-based model to identify covid patients using 450 X-ray images, in which 250 images belong to covid patients and the 200 images belong to healthy people. He applied this concept in 3 Convolutional Neural Network models:- Residual Network-50, Residual inception v-3, and inception Convolutional Neural Network using five-fold cross-validation and submitted the report that Residual Network-50 had the only detection accuracy (98%) [2].

Another similar study which is conducted by Sethy and Behera, the authors extracted the attributes by using Deep Convolutional Neural Network algorithm from chest X-ray images and classified images as either infected or healthy using a SVM [3]. They collected two datasets the first dataset contains the collection of 25 infected patients images and 25 non-infected patients images while the other dataset contains X-ray images of 133 infected patients and 133 non-infected patients. They applied separate feature extractions on each dataset using various models and achieved a 94.38% accuracy with ResNet- 50 and SVM [3].

Furthermore, Hemdan et al put forward a framework, called Covidx-net, which will assist radiologists in diagnosing covid patients using X-ray [9]. They evaluated their framework employing a collection of data of fifty X-ray images divided into two classes: 25 covid- positive person images and 25 covid-negative person images. The images used were resized to 224×224 pixels. The COVIDX-Net framework employs 7 deep learning models such as : MobileNet. ResNet-v2. The authors trained model outcome indicate that the VGG19 and DenseNet models delivered comparable execution with an F-score of 91% for COVID-19 cases [9]. In addition, Hassanien et al proposed an arrangement that uses multi-level thresholding and an SVM to identify covid persons by the help of using X-ray images [11]. Their model was implemented by using 50images (20 healthy and 30 covid infected) with a resolution of 512×512 pixels. Their arrangement achieved a performance of 94.32%, accuracy of 94.64% and specificity of 96.7% .

III. METHODOLOGY

a)Data Collection

To validate the proposed method, we require two types of chest related x-ray images they are common x-ray image and the other one is covid affected patient x-ray image [1]. While chest X-ray images of common category had been collected from a GitHub or from Kaggle dataset which contains some images selected from Chest X-ray dataset. Granting them in a notable number of infected COVID-19 patients universally, but chest x-ray images that are accessible online are not mostly significant and dispersed. Kaggle chest X-ray data is a far-fetched popular database containing chest X-ray images of normal or healthy, viral, and bacterial- pneumonia. Positive and mistrust CORONA VIRUS images were acquired in open available resources. Lungs X-ray images for regular and effected with pneumonia were used from this gathering to generate the up to date database collection.

Fig -1: Sample Dataset X-ray images

b)The CNN architecture

This model aims to organize a given chest X- ray image into common or COVID-19 category which contains few various stages gathering, pre-processing, feature selection, feature extraction, training [4]. The detailed information of each stage has been in the following sections. The first stage is gathering, in this process we can collect the overall x-ray images in which it consists of both covid and non-covid x-ray images [6].

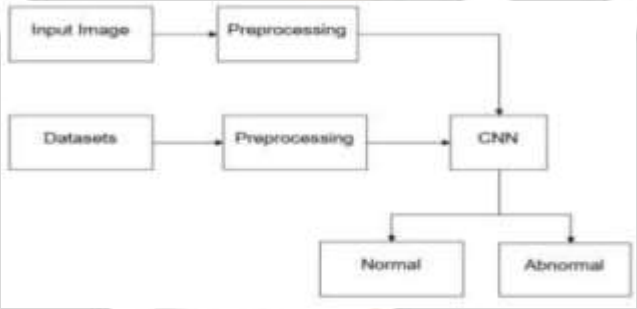

Fig -2: Flow diagram for the CNN architecture.

Pre-processing refers to all transformation of the image before it is fed to the machine, training a CNN on the images. The Techniques Provided in Data Pre-processing. Data Cleansing. Cleaning "dirty" data [2]. Real-world data tend to be incomplete, inconsistent and noisy. Data Integration, combining data from multiple sources, Data Transformation. Constructing data cube, Data Reduction. Reducing representation of data set [5]. Data which tends to be incomplete leads to inconsistency and noise that affects the remaining part of the data containing x-ray attributes.

A selection algorithm can be seen for presenting new characteristics subsets, along with an approximation measure which tells the different detail subsets [9]. Feature selection is used to simplify the models to make them users to be interpreted, and used to enhanced generalization by decreasing over fitting, avoid the curse of dimensionality [7].
Feature extraction is also involved in minimizing the amount of available sources needed to describe a huge set of information. One of the major problems, while performing or analyzing the complex data is the problem arise from the amount of variables involved in it [4]. By examine of huge amount of the variables we required a huge amount of memory study power, and it also cause a sorting algorithm of over fitting samples and observe poorly to latest samples.

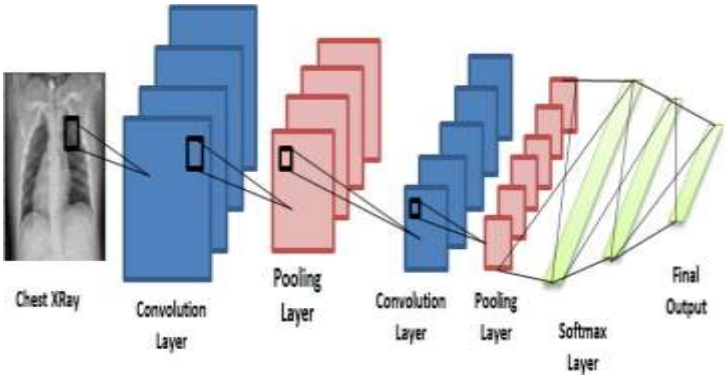

Fig -3: Architecture of CNN Diagram of Proposed Method

CNN is very efficient algorithm which is used for image processing and pattern recognition. It has some features such as simple structure, less training parameters and adaptable [3]. To training this model we required to indicate input training data source, required data transformation instructions, name of the Information allocate that data to be anticipated.

IV. RESULTS

CNN Model

The CNN model is trained with chest x-ray images from dataset. The CNN model is trained with 300 X-Ray images in 80:20 ratio.

Basic measures derived from the confusion matrix:

Accuracy (ACC) is calculated as the number of all correct predictions divided by the total number of the dataset. The best accuracy is 1.0, whereas the worst is 0.0. It can also be calculated by 1 – ERR.

Accuracy = (TP+TN)/(P+N)

Precision (PREC) is calculated as the number of correct positive predictions divided by the total number of positive predictions. It is also called positive predictive value (PPV). The best precision is 1.0, whereas the worst is 0.0.

Precision = TP/TP+FP

Error rate (ERR) is calculated as the number of all incorrect predictions divided by the total number of the dataset. The best error rate is 0.0, whereas the worst is 1.0.

Error Rate=(FP+FN)/(P+N)

False positive rate (FPR) is calculated as the number of incorrect positive predictions divided by the total number of negatives. The best false positive rate is 0.0 whereas the worst is 1.0. It can also be calculated as 1 – specificity.

FP= FP/TN+FP

The performance analysis results are as follows:

Sl. No	1
Dataset	Chest X-Ray images
Data Set Split	Total=300 Training=80% Testing=20%
Error Rate (ERR)= FP+FN/P+N	6%
Precision =TP/FP+FN	0.94
Accuracy =(1-ERR)	±94%

Table -1: Performance analysis of X-ray images

In this, we had presented a method that could screen COVID-19 fully automatically by CNN. The model was trained on chest X- ray images of COVID-19, normal and viral pneumonia. We have obtained the best performance as a classification accuracy of more than 98%. We have set the training steps to 100, which is sufficient to generate sufficient outcomes. Training accuracy increased as training proceeds after 100 iterations, the final test accuracy was ±97%.

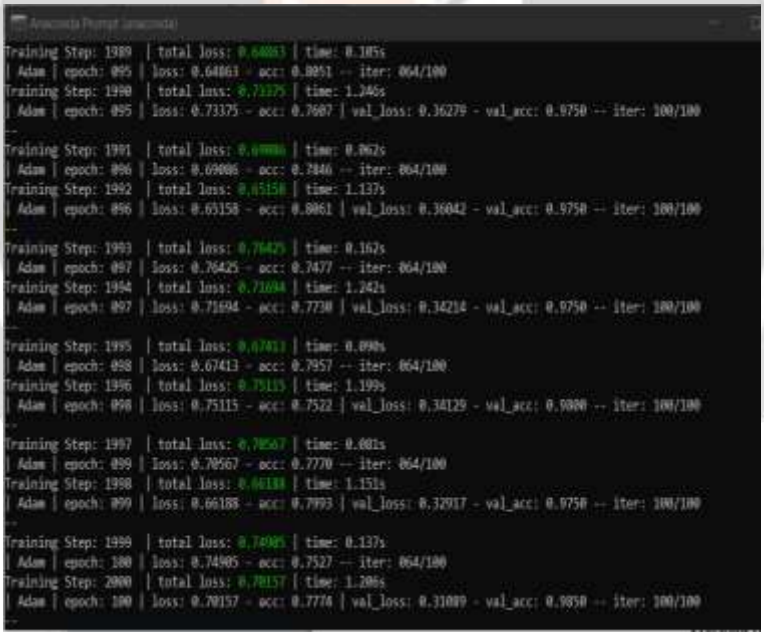

Fig -4: Final test accuracy of the training

The below Figure shows the results when the sample test image was taken to predict the image or classify the image into Covid or Pneumonia or normal. The result will be displayed on the application.

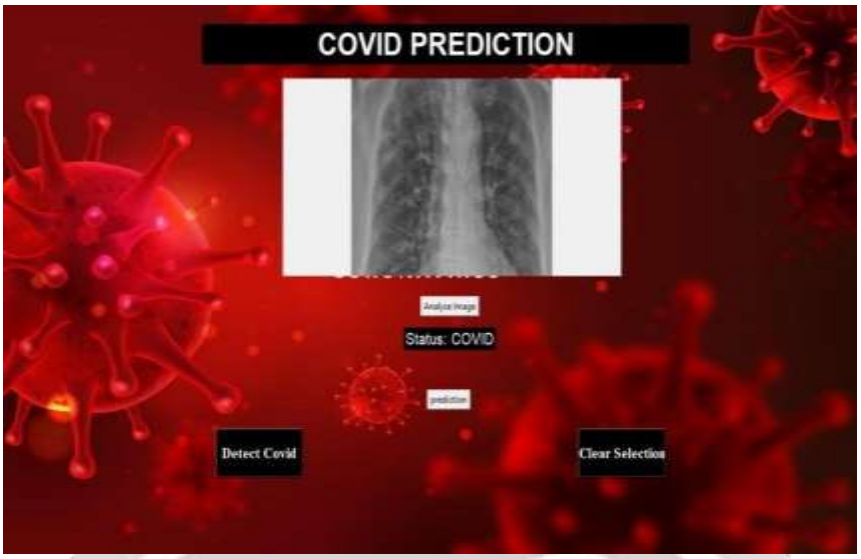

Fig -5: Result obtained by testing the Image.

After classification of image we added a feature button called PREDICTION it displays the value of Prediction on Y-Axis.

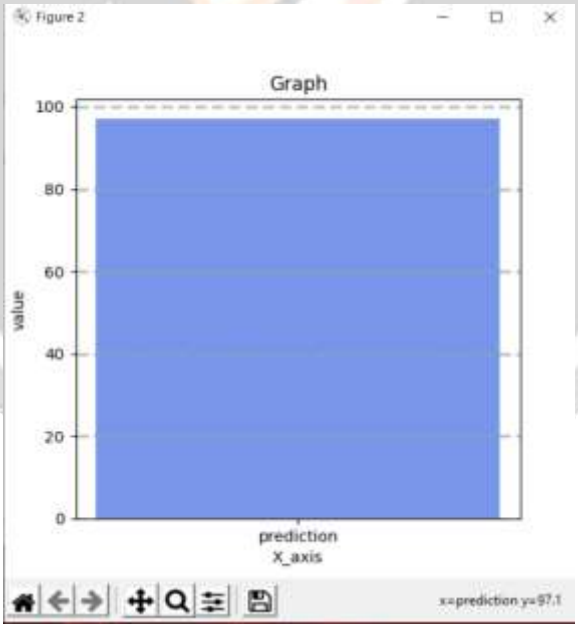

Fig -6: Displays value of prediction for covid image.

V. CONCLUSION

It is evident that recent advances have been made in the diagnosis of COVID-19 detection it lacks the early diagnostic tools. Even though there are several methods achieved noticeable advancements with high sensitivity or less false positive. There are many challenges to be

addressed, to overcome all these challenges we are proposing CNN method. The reason to choose CNN is that it can extract the spatial from the data using kernels, which other networks are not capable of. The proposed method uses CNN for the detection of COVID- 19 based on the chest radiography X-ray images. A CNN is collection of numerous fully connected and thresholding layers, followed by different layers that determines the result. It is observed that X-Ray images gave accurate analysis of the covid19 detection with almost ±94% accuracy rate.

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