X-Ray Based Quick Covid-19 Detection Using Raspberry-pi

Ujjwal Pandey[1], Payal Prajapati[2], Rahul Kanade[3], Prashant Singh[4], Dr.Jyoti Dange[5]

[1-4]BE Students, Dept. of Electronics and Tele-Communication, Atharva College of Engineering, Mumbai, India
[5]Professor, Dept. of Electronics and Tele-Communication, Atharva College of Engineering, Mumbai, India

---

Abstract - *The COVID-19 epidemic continues to have devastating effects on the health and well-being of the world's population. An important step in combating COVID-19 is to successfully diagnose infected patients, one of the main methods of evaluating radiological imaging using X-ray. This machine can detect whether a person is infected with the virus from x-rays of a person's lungs through machine learning. The data list contains 864 COVID-19, 1345 viral pneumonia and 1341 chest x-ray images. This device uses image processing by machine learning and determines whether they have it or not. It can be integrated with an x-ray machine and today more sophisticated digital x-ray machines are used and that is why image processing can be very accurate with this machine. This method is faster than the current method and, in this way, we can perform more than 98% accuracy test (97% training accuracy and 93% verification accuracy). The results show that transmission studies have been shown to be effective, demonstrating robust performance and easy-to-use methods for the detection of COVID-19.*

Key Words: Covid-19 Detection, Raspberry-pi, CNN Algorithm, Machine Learning, Image Processing, Social Distancing, X-ray Based.

1. INTRODUCTION

In this age of epidemic testing, it is important and the number of tests should be increased daily to get accurate data and practice but, with the current test method it takes a few hours to get the results and sometimes if the number of tests in large quantities takes longer to get the results. Previous plans to receive Covid-19 have taken time to provide reports when a person with the virus needs immediate attention. Also, all such visual systems use components that need to be discarded after each use, which creates a huge demand for immature items but when we do x-ray it can be done very quickly.

2. LITERATURE SURVEY

[1]Automated Detection of Covid-19 cases using Deep neural networks with X-ray :- Tulin et al. 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.

[2]Covid-19 from chest X-ray images :- Khan et al. in his paper he proposed a model named "Coro-Net," 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 ImageNet and then it is trained on a dataset that was gathered from various publicly 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 per cent and 98.2 per cent 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%.

3. PROBLEM STATEMENT

In order to control the spread of COVID-19, a large number of suspected cases need to be isolated and appropriate treatment evaluated. Pathogenic research center testing is the best quality indicator yet troubles with significant negative results. Rapid and accurate analytical techniques are widely expected to fight disease. Because of COVID-19 radiographical changes in X-ray images, we intended to develop a more comprehensive study approach that could extract the graphic features of COVID-19 to provide clinical analysis prior to pathogenic testing, thus saving critical time control.

4. METHODOLOGY

1. The system uses Raspberry Pi 3B+ as the microcontroller in the system.
2. A SD Card preloaded with Raspbian OS is used.
3. Laptop/PC with ethernet cable or Monitor/TV with HDMI cable can be used as display for the Raspberry Pi 3B+.
4. A publicly available chest X-ray images dataset is taken for the development of the system.
5. Steps like exploration, cleaning, transformation etc. Would be applied to make the dataset suitable for use.
6. Once the dataset is ready, we will split it into train and test dataset.
7. ML Model will be used for training and testing and accuracy will be determined.
8. Once everything is done then the user can provide test data for prediction of covid-19.

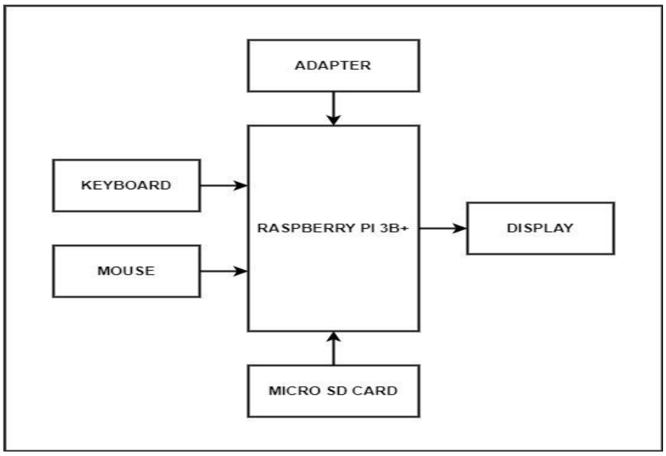

Fig -1: Block Diagram

5. THEORY AND WORKING

CNN usually does better with a larger database than a smaller one. Transferring readings can be beneficial for those CNN applications where the database is not large. The concept of transfer learning using a trained model from big data sets such as ImageNet is used for a relatively small database application. This eliminates the need for large databases and reduces the duration of training as more in-depth learning algorithm is required when developing from scratch.

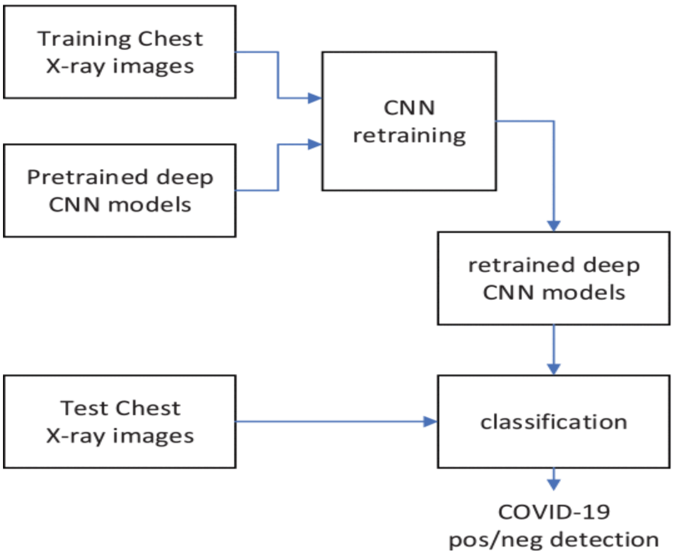

Fig -2: Working

5.1 Collection of Dataset

In this study, 315 chest X-ray images of COVID-19 patients were found in an open source GitHub shared by Drs. Joseph Cohen. This room contains chest X-ray / CT images of patients mainly with acute respiratory distress syndrome (ARDS), COVID-19, Middle East Respiratory Syndrome (MERS), pneumonia, acute respiratory syndrome (SARS). In addition, 330 radiographic positive images of COVID-19 (CXR and CT) were carefully selected from the Italian Society of Medical and Interventional Radiology (SIRM) COVID-19 DATABASE. Of the 330 radiographic images, 70 images are chest x-ray images and 250 images are lung CT imaging. The website is being updated randomly and as of March 29, 2020, 63 verified COVID-19 cases have been reported on this website. In addition, 2905 chest X-ray images were selected from the COVID-19 Radiography database. Of the 2905 radiographic images, there are 219 COVID-19 positive images, 1341standard images.

Fig -3: Example chest radiography images

5.2 Image Pre-processing

One of the key steps in data processing was to resize the X-Ray images as the image input of the algorithm was different. We have implemented a specific image processing method to maximize the performance of our system by speeding up the training time. First, we resized our images to 299x299x3 to extend processing time and fit into Inception V3. In the pre-image processing step, we need to label the data as the convolution neural network learning method equates to controlled reading in machine learning.

5.3 Image Augmentation

CNN needs a fair amount of data to get the best performance. We use data enhancement techniques to maximize insufficient data in training, and the techniques used include vertical rotation, horizontal rotation, sound, translation, blur and rotation image 60 °, 90 °, 180 °, 270 °. Figure 3 shows an example of the data addition used. Thus, the original database comprising 864 COVID-19 images, 1341 standard images, and 1345 viral pneumonia images was expanded to 8,640 COVID-19 images, 13,410 X-images. common chest rays, as well as 13,450 images of bacterial pneumonia as shown in. Table I.

Class	Images	Augmented Total	With Augmentation		
			Training	Validation	Test
COVID-19	864	8640	7340	500	800
Normal	1341	13410	12000	910	500
Viral Pneumonia	1345	13450	12000	950	500

Table -1: Details of training validation and test set

5.4 Transfer Learning

Transfer learning is a machine learning method based on the concept of reusable Learning transfer is commonly used with CNN in the way all layers are stored except for the last, trained for a specific problem. This procedure can be especially helpful in medical systems as it does not require a

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 01 | Jan 2022 www.irjet.net p-ISSN: 2395-0072

lot of training data, which can be difficult to obtain in medical settings. In the analysis of medical data, the biggest difficulty researchers face is the limited number of available data sets. In-depth learning models often require a lot of data. Labeling this data professionally is expensive and time consuming.

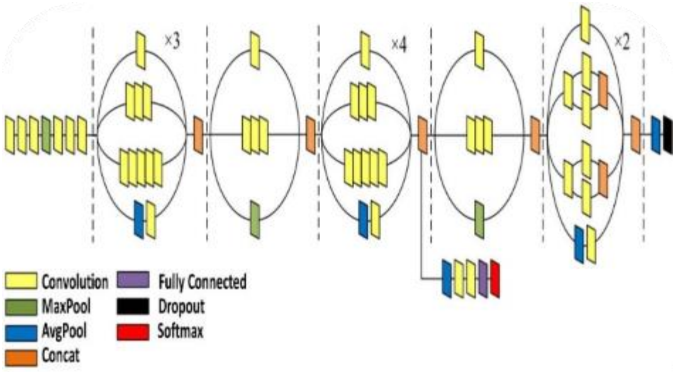

Fig -4: Inception V3 architecture

Figure 4 describes the Inception V3 model that enables convolution, pooling, SoftMax and fully integrated processes. Here a pre-trained neural network designed for one job can be used as a starting point for another task.

The Inception-v3 structure consists of two pieces:

1. Use the extraction phase feature of the convolutional neural network.
2. The partition section uses layers that are fully integrated with SoftMax layers.

5.5 TensorFlow

It is a synthetic neural network with more than three layers, shown in Fig. 5. It has single input, single output and multiple invisible layers. In order to use transfer readings to separate chest X-ray images, we used the TensorFlow library to download the Inception V3 model to our local machine, retrained it to the chest X-ray database and split the new images into one of three common categories, viral pneumonia and COVID-19. It is an in-depth learning framework developed by Google that can control all the neurons (nodes) in the system and has a library suitable for image processing.

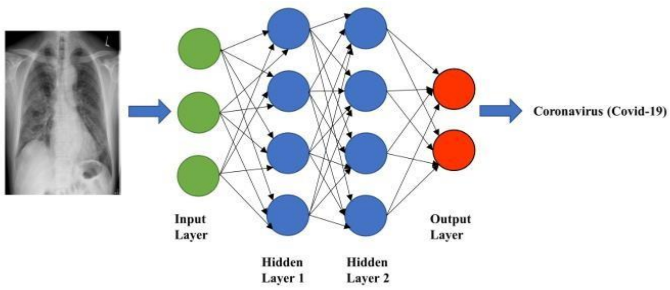

Fig -5: Neural network classifier

5.6 Proposed Architecture

Fig. 6 provides a step-by-step procedure for the proposed work model. The steps for the projected classification architecture are as follows:

1. Recursively perform convolution and pooling on images.
2. Apply drop out and fully connected. Now the image must be classified according to the labelled training class.

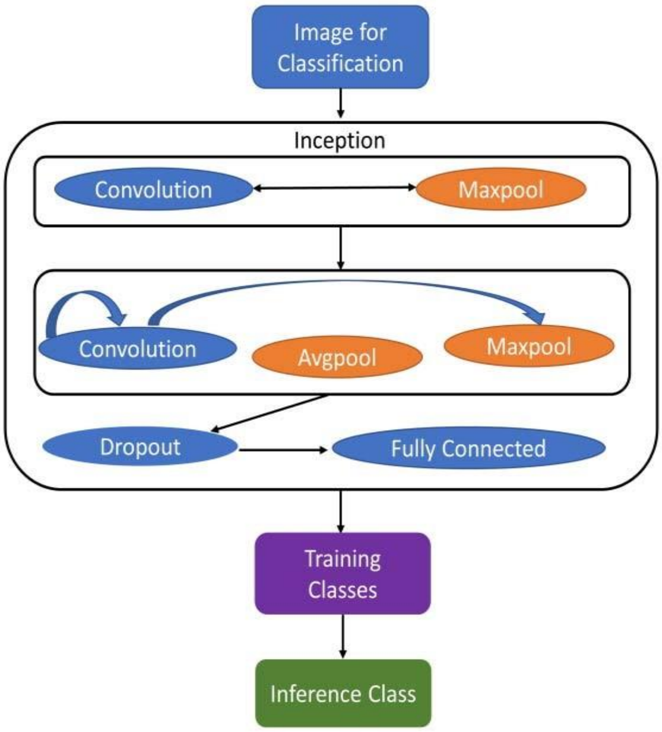

Fig -6: Proposed work architecture

Convolution is a slow process. It removes various input features. Each kernel is responsible for producing output activity. Low-level elements of the image, such as edges, lines, and corners are determined by the lower layer, and the higher features are rendered in the upper layer. Blending is used to make the features found in convolution strong against noise. Combining layers are usually of two types namely, intermediate integration and large integration. The size reduction step or output factor. A simple example of max and average pooling is shown in Fig. 7.

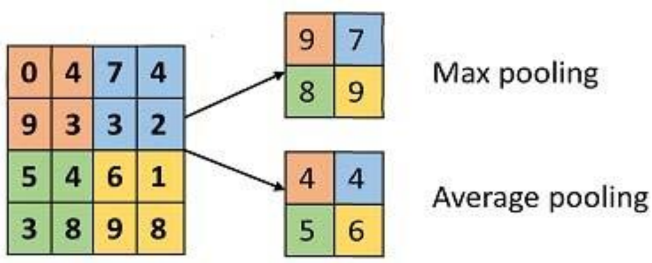

Fig -7: Example of max and average pooling

In this study, we developed an DCNN-based InceptionV3 model for classifying COVID-19 Chest X-ray images into normal, viral pneumonia and COVID-19 categories. In addition, we used the transfer learning method obtained using ImageNet data to overcome insufficient data and training time. A standard CNN representation that includes the InceptionV3 model for patient prediction of COVID-19, viral pneumonia and generalization is shown in Fig. 8. Chest X-ray images are considered as embedded, Inception V3 is used, convolution, pooling, SoftMax, and fully integrated procedures are performed. Upon completion of these activities, they were categorized according to different training modules and eventually classified as normal, bacterial pneumonia and COVID-19 classes.

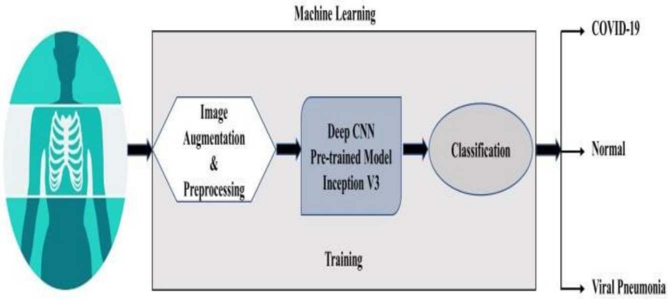

Fig -8: Schematic representation of pre-trained model for the prediction pf covid-19 patients, normal and infected

Inception V3 is one of the regions of architectural art in the challenge of image classification. The best network for medical imaging analysis seems to be the structure of Inception V3 and is much better than the latest architecture. Therefore, we have selected the Inception V3 model which is used using TensorFlow and that is why retraining is done with TensorFlow.

The steps for classification using the proposed activity are as follows

Algorithm TensorFlow Classification
Step 1: Get started
Step 2: Create a list of images // start training the model
Step 3: Provide a list of storage quantities for each bottle picture
Step 4: Provide insight into images // to create Bottleneck values.
Step 5: Create a folder for all bottle price pictures
Step 6: Generate bottleneck values for each image
Step 7: Create new SoftMax layers and fully integrated layers // at the end of training
Step 8: Check the new image // insert a chest x-ray image to get the result
Step 9: Finish

Fig -9: Datasets and CT scans

6. EXPECTED RESULTS

In this study, we introduced a new way to automatically detect COVID-19 by CNN. Chest X-ray images were used to predict patients with COVID-19. The famous previously trained Inception V3 model has been trained and after training, the model was spotted on the chest.

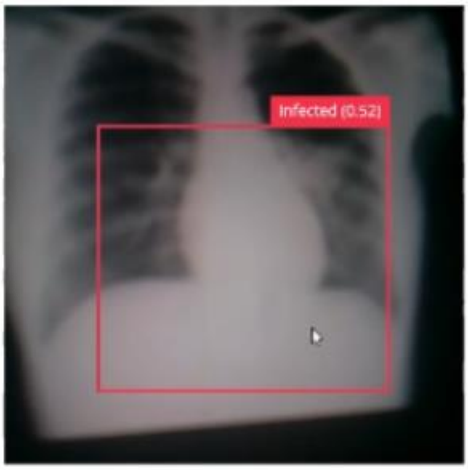

Fig -10: Infected Lungs

Fig -11: Infected Lungs

Fig-12: Uninfected Lungs

7. CONCLUSION

The Covid-19 X-Ray test method is proposed and discussed in this project. It is inexpensive, effective and can be used for early diagnosis. It will use a variety of Machine Learning methods that provide accurate results and an increase in accuracy with the size of the database and the models used. This way we can do more tests and we can get results faster and we can get more data that can suggest how we should manage the health care system and vaccination policy.

REFERENCES

[1] WHO. (2020). WHO Director-General's opening remarks at the mediabriefing on COVID-19 - 11 March 2020. Available: https://www.who.int/dg/speeches/detail/who-director-general-s-openin g-remarks-at-the-media-briefing-on-covid-19 11-march-2020

[2] CDC. (2020). Coronavirus Disease 2019 (COVID-19). Available: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/p eople-at-higher-risk.html

WHO. (2020, 02 November). Coronavirus disease (COVID-2019) situation reports. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/?gclid=Cj0KCQjw2PP1BRCiARIsAEqv-pTBlRc57bU VrAh6-9j_hkakBVk_n_TkbXjtgjVBcVizs7h83yH7YUEaAoVHEALw_wcB

[3] J. H. U. a. Medicine. (2020). COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)Available: https://coronavirus.jhu.edu/map.html

[4] W. Wang et al., "Detection of SARS-CoV-2 in Different Types of Clinical Specimens," (in eng), JAMA, 2020/03// 2020.

[5] D. Wang et al., "Clinical Characteristics of 138 Hospitalized Patients with 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China," JAMA, vol. 323, no. 11, pp. 1061-1069, 2020.

[6] [7] N. Chen et al., "Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study," The Lancet, vol. 395, no. 10223, pp. 507-513, 2020.

[7] [8] Q. Li et al., "Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia," vol. 382, no. 13, pp. 1199-1207, 2020.

[8] C. Huang et al., "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China," The Lancet, vol. 395, no. 10223, pp. 497-506, 2020.

[9] V. M. Corman et al., "Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR," vol. 25, no. 3, p. 2000045, 2020.

[10] D. K. W. Chu et al., "Molecular Diagnosis of a Novel Coronavirus (2019-nCoV) Causing an Outbreak of Pneumonia," Clinical Chemistry,vol. 66, no. 4, pp. 549-555, 2020.