Prediction of COVID-19 cases using chest X-ray images by deep learning algorithms

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ABSTRACT

Coronavirus diseases 2019 (COVID-19) is caused by the corona virus has affected and damaged health and global well-being. Number of people were affected by this virus and it is rapidly spreading throughout the world. The facility to test the virus is still poor in most of the hospitals across the world. The RT-PCR test which has been done manually is highly time consuming. Thus came the importance of an automated diagnosis system which gives a fast decision and less error also. Deep learning algorithms with the help of chest X-ray images have become a good solution for this nowadays. This paper proposes a before time detection of COVID-19 disease using X-ray images and convolutional neural network algorithms.

Keywords: CNN, Deep learning, Image classification, prediction, X-ray images

I. INTRODUCTION

COVID-19 disease is a contagious disease caused by the virus SARS-CoV-2. In Dec 2019 in China the first case was detected. This disease spread throughout the world leading to pandemic condition. The symptoms of this disease are different, but may include cough, breathing difficulty, fever, loss of smell and taste and fatigue. Around the world more than 5 million people world got infected as per the report of WHO [1]. In an infected person, it will take almost fourteen days to show the symptoms. Currently no treatment or drug is invented to treat this. Commonly RT-PCR [2,3] test will be conducted to detect this disease.The virus can also be detected by analysing the chest X-ray, since this disease infected more in the lungs [4,5].This diagnosis is performed by radiologists manually [6]. Compared to RT-PCR, X-ray imaging was used extensively for COVID-19 prediction since it takes less time, wide availability of X-ray scanners and lower cost. But the main problem with X-ray imaging is the accuracy of the prediction. The analysis of X-ray images by radiologists at a big scale is lengthy and sometimes direct to erroneous prediction due to the be short of of earlier knowledge about the infected areas. So for faster and very accurate prediction of COVID-19, an automatedsystem is highly recommended. Deep learning techniques can be adopted for this. Deep learning using CNN can be widely used

for chest disease predictions.

The foremost aim of this automated system using machine learning is to analyses the characteristics of disease and provide some valuable predictions. Thus the main steps involved are pre-processing of the images, segmentation of the interested regions related to the disease, computing effective features and building feature based machine learning models for detection and classification. For example, a classification of COVID-19 & non COVID-19 cases using KNN model provides an accuracy of 96.1% [7]. Many DL models have been included in the literature to classify and detect COVID-19 cases [8 -16].The proposed method develops a deep learning based covid prediction from chest X-ray images. This scheme classifies images into two classes such as COVID-19 infected and non COVID-19 infected.

CNN or Convolutional Neural Networks is one of the important algorithm in ANN to do classification of images. In this proposed model the system takes the chest X-ray as input images and process it and classify to either COVID positive or negative. The DLCNN consists of a set of convolution layers, kernals or filters, pooling layers and a final fully connected layers. The activation function used was softmax with values between zero and one. The overview of the proposed system is shown in fig1.

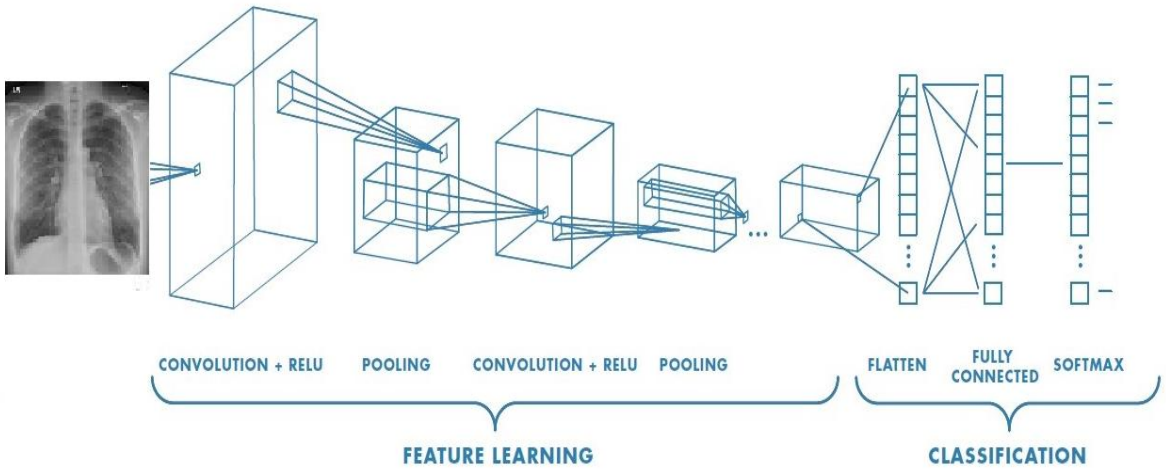


Fig.1 System overview

II. MATERIALS AND METHOD

In the proposed method the validation has been done using a set of chest X-ray images which are collected from the available datasets [17-19]. Total images used are 300, out of which 224 images were used for training and 60 images for testing. 150 images were in COVID positive category and else in COVID negative category.

III. PROPOSED METHODOLOGY

The proposed model is designed in such a way that the classification of COVID positive images has to be done in a very accurate manner. The classification has been done using a pre-trained convolution neural network model. Fig.2 shows the proposed model.A convolutional neural network takes the image as input and classify it into a category by assigning learning weights and biases. CNNs are fully connected networks. Overfitting can be avoided by providing this structure. The connectivity pattern among neurons resembles the structure of a human brain. A series of convolutional layers are interconnected and it constitute the hidden layers. The ReLU[20] activation function is commonly used. In between the input and output layers, there will be pooling layers, normalization layers and fully connected layers[20].

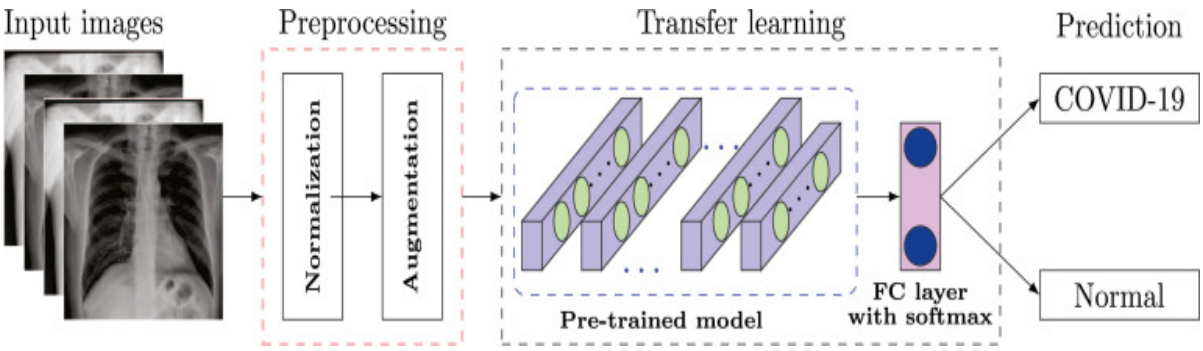
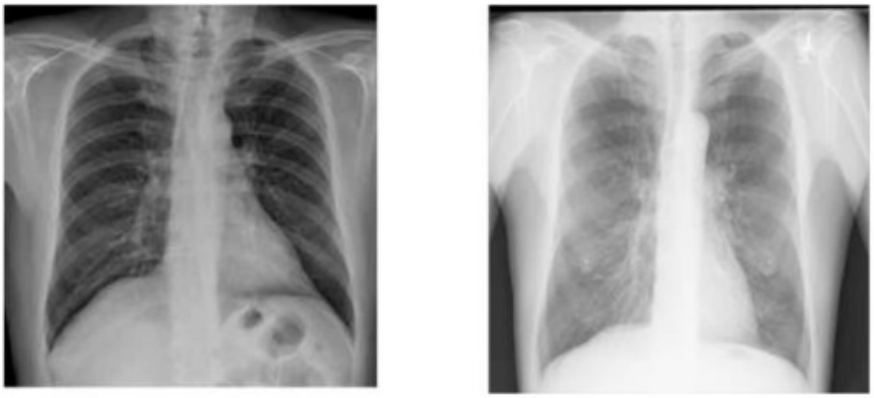


Fig.2 Proposed system model

For getting a numerical stability in CNN architecture, normalization will be an essential step. With normalization this model will learn faster and the gradient descent algorithm will be likely to be stable. Before applying to the model, the input image size has been converted into 224x224x3 size.



(a) (b)

Fig 3. Sample images from data set. (a) COVID-19 positive case (b) COVID-19 negative case

The architecture of the proposed model is shown in figure 4. The input image is given to 2D CNN layer with number of filters used is 32. The pooling used here is the max pooling of size 2x2. ReLU activation function is used [21]. In the second and third convolution layer the number of filters used is 64. 128 filters are used in the final convolution layers. The size of the filters used are 3x3. In the fully connected layer sigmoid activation function was used.

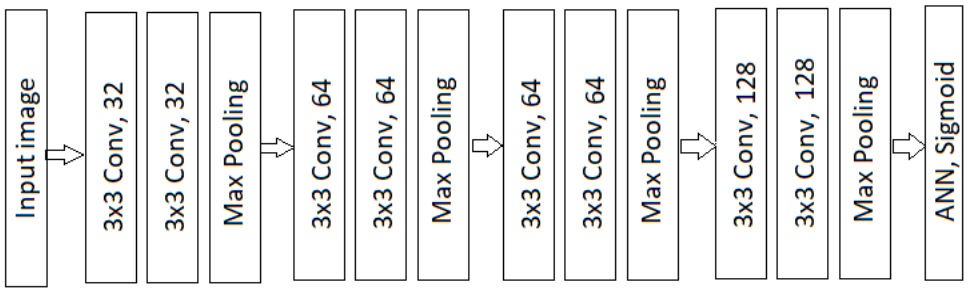


Fig4. Proposed architecture

IV. EXPERIMENTS AND RESULTS

In the proposed method the total images used are 300, including COVID-19 positive and COVID-19 negative cases. 75% of the images were used for training and 25% images for testing. 150 images were in COVID positive category and else in COVID negative category. The training accuracy obtained is 0.9643 and the testing accuracy is 0.9688.

V. CONCLUSION

A deep learning based system for the categorization of COVID-19 infected cases from ordinary cases was anticipated. Chest X-ray imagery were used for the classification. The main steps involved are pre-processing of the images, segmentation of the interested regions related to the disease, computing effective features and building feature based

machine learning models for detection and classification.The proposed model is a binary classification system, that is classification of COVID positive and COVID negative.Classification of multiclass problems will be considered in future.

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