IDENTIFICATION OF CORONAVIRUS DISEASE FROM CHEST X-RAY PICTURES USING CNN

MAHENDER VESHALA
Assistant Professor, Dept of ECE, KUCET, Kakatiya University, Warangal Telangana.
mahi415@gmail.com,

T. SRINIVASULU
Professor, Dept. of ECE, KUCET, Kakatiya University, Warangal Telangana
drstadisetty@gmail.com

ARSHIYA RUBEENA
M. Tech Students, Dept of Digital Communications, KUCET, Kakatiya University, Warangal Telangana
arshiyar666@gmail.com

Abstract: *The detection of severe acute respiratory syndrome coronavirus 2 (SARS CoV-2), which is responsible for coronavirus disease 2019 (COVID-19), using chest X-ray images has life-saving importance for both patients and doctors. Therefore, it is very important to evaluate the affected patients quickly and cost-effectively to combat this disease. Radiographic examination is one of the best viable steps to achieve this goal, with chest radiography being the least effort and least expensive option that can obtain. This article proposed a whole convolutional neural network-based solution to locate five COVID-19+ patients using chest X-ray imaging. Several recent CNN fads, DenseNet201, Resnet50V2, and Inceptionv3, have been adopted within the proposed work. For my part, they have been adept at making unbiased predictions. The models are then shuffled to wait for the category rate. To verify the efficacy of the response, we openly used chest X-ray images of COVID + ve and –ve cases. A mean sensitivity of 93.84%, mean specificity of 99.18%, mean accuracy of 98.50%, and mean receiver operating characteristics–area under the curve scores of 96.51% are achieved. A convolutional neural network without pre-processing and with minimized layers is capable of detecting COVID-19 in a limited number of, and in imbalanced, chest X-ray images.*

Keywords: *COVID-19, pneumonia, X-ray, convolutional neural networks, coronavirus*

I. INTRODUCTION

Coronavirus, as confirmed with the help of the World Health Organization [1], constitutes the first respected case in Wuhan, the most important urban area of Hubei Province in China. It has already cost many lives so far and has hundreds of thousands of confirmed cases worldwide. An epidemic that takes the form of a pandemic has a disastrous effect on the fitness and well-being of the world's population. This has caused severe acute respiratory syndrome coronavirus (SARS-CoV) and the disease is known as coronavirus disease 2019 (short for COVID-19) [2]. This coronavirus belongs to the circle of relatives identical to SARS and MERS, but they have a more lethal and aggressive nature (2019-nCoV). This contagious infection spreads faster (by respiratory droplet infection) than other common valves. At this time, the general public for tests used to diagnose COVID-19 are preparing genetic controls called reverse transcriptase polymerase chain reaction (RT-PCR).

AI tools have produced stable and valid effects within applications that use both image-based data and different types of facts in the use of Covid-19 X-ray images. In their observation, they considered the transport to see the use of pre-trained networks, including VGG19, MobileNet

V2, Inception, Xception and Inception ResNet V2, which are the most commonly used. Various rating scales were used to evaluate the results received from various data sets. MobileNet V2 and VGG19 performed with 97%, 40%, 98%, and 75% accuracy, respectively, for two class trials (COVID-19/Normal and COVID-19/Pneumonia), and 92%, 85% and 93 48% for three elegance trials (COVID-19/pneumonia/normal). The authors reached a conclusion using acquired confusion matrices, not exact results due to unbalanced records [3].

ConvNets deep network has been implemented in many reputable and high-resolution imaging software, accelerating its reliability for targeted studies. Identification of most prostate cancers by computed tomography. Yun and colleagues used 12 CNNs to determine tumour identity in images of the colon and rectal tissue. This and other research have influenced researchers to see if AI and networking can be properly used in COVID-19 studies, particularly in diagnostic software. Recently, Apostolopoulos and Mpesiana2 took a look at the COVID-19 novel classification. They considered it exceptional, in public, to take chest X-rays. The method of training is done by using ConvNet with the transfer of knowledge acquisition with pre-qualified networks. They concluded that VGG19 and MobileNet-V2 outperformed various pre-learning ConvNets. Every educated neurological community benefit from understanding a particular task under study. While the main principle of artificial neural networks is to simulate human behaviour and intelligence, the change being studied in artificial neural networks is used to apply the knowledge saved by a selected company to all other associated projects. Gaining in-depth knowledge of image recognition applications allows mastering thousands upon thousands of images, and many mega-fashions have been trained using different architectures. These specialized fashions have been previously shared for all researchers to use. Stored experience. Ultra-modern networks, previously learned and suitable for general use, were considered under evaluation, notably VGG16, VGG19, ResNet50, InceptionV3, MobileNet-V2, and Densenet121 [4].

II. RELATED WORKS

Motivated by the need for faster interpretation of X-ray images, some artificial intelligence (AI) structures entirely based on deep knowledge have been proposed. The results are very promising accuracy in detecting inflamed COVID-19 patients via X-ray, focusing mainly on imaging images. Computed tomography. However, to the authors' knowledge at the time of the initial release of the COVID-Net proposal, most of the advanced AI architectures proposed in the research literature were closed. They were not available for the study network to develop deeper knowledge. - How and how much these systems. Moreover, most of these systems are not available for public access and use. Significant efforts are currently underway to advance open access and open supply AI solutions for X-ray-driven COVID-19 case detection, with an exemplary effort being the collection of open-source COVID-19 imaging data, an effort by Cohen et al. Sixteen to build a dataset consisting of COVID-19 cases (plus severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS) cases) with annotated

CXR and CT images, for the study community and citizen fact scientists can leverage the dataset to discover and build Artificial intelligence frameworks for COVID-19 detection. From the time of the initial public release of the proposed COVIDx dataset and the proposed COVID-Net, many

Research in the field of COVID-19 detection has been conducted using CXR26–38 images, many of which have used the COVIDx or COVID-Net dataset versions to conduct such studies. Based on a comprehensive survey of studies in the research literature, they have focused primarily on exploring deep learning, especially deep convolutional neural networks, given the significant successes and new developments in various imaginative and insightful commitments.

The fictional and prophetic computer has identified a prominent use in medical analysis. It is useful in scientific fields that require visual examinations, such as dermatology. The virtual and prophetic computer is used to diagnose whether skin abnormalities are an early indicator of the ability of most skin cancers. It is also used to identify problems within the body, especially within tissues, blood vessels, joints, etc. It is used in ophthalmology to diagnose diseases such as diabetic retinopathy, so it helps prevent blindness. In addition, he has shown incredible success in surgeries as well as treatments. Computer vision responses use different types of scientific imaging, for example, computed tomography (computed tomography) experiment, magnetic resonance imaging (MRI), positron emission tomography (PET) test, ultrasound, and chest radiography (CXR).

Studies show that medical images help in improving the analysis of the presence of viruses in the lungs. In multiple works, deep learning-based techniques have been developed to identify pneumonia [5], diferent classes of thoracic diseases [6], skin cancer [7], haemorrhage classification [8], etc. from medical images. Some of these works have given promising results with relatively simple architecture.

III. MATERIALS AND METHODS

Dataset

A total of 225 COVID-19 chest X-ray images were obtained from Cohen;18 they can be accessed from github.19 The average age for the COVID-19 group was 58.8±14.9 years, and it comprised 131 male patients and 64 female patients. Note that some patients' information is missing; this is because the dataset used in this study does not have accompanying complete metadata, because this is the very first publicly available COVID-19 X-ray image collection, and it was created in a limited time. In addition, 1583 normal and 4292 pneumonia chest X-ray images were obtained from Kermany et al.20 All images were in different dimensions, so they were resized to 640 × 480. For Class 0 there are 538 images similar to images shown in Fig. 1 whereas for Class 1 there are 468 images of COVID negative patients similar to images in Fig. 2

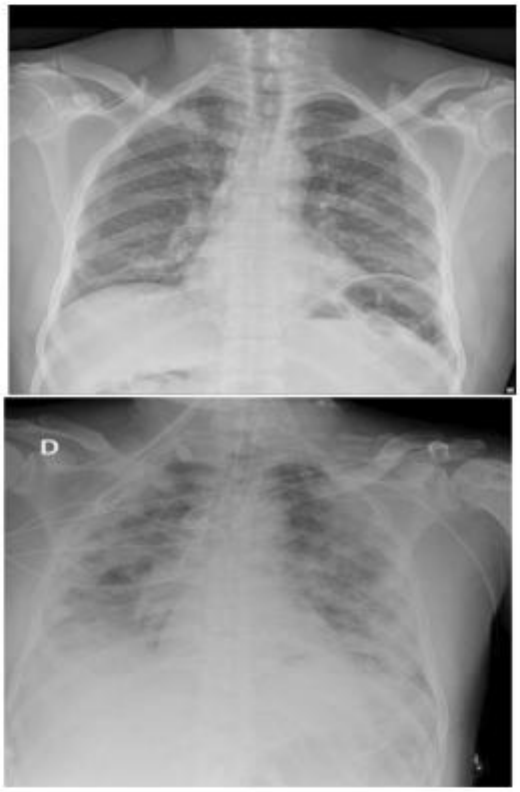

Fig.1 CXR images of COVID-19 positive subjects

Fig.2 CXR images of COVID-19 negative subjects

Design of Experiments

Several categorized experiments were performed to evaluate the efficiency of the ConvNet on the considered image database and to compare ConvNet with other models using the basic statistical characteristics of the images, which can provide effective information for classification. Experiments were divided into three categories: ConvNet experiments, statistical measurement experiments, and transfer learning experiments. ConvNet Experiments. ConvNet experiments were performed on three subcategories: COVID-19/Normal, COVID-19/ Pneumonia, and COVID-19/Pneumonia/Normal. They included the use of four different network architectures with varying numbers of convolutional and fully connected layers, and basic image pre-processing techniques to test the results using various structures and pre-processing methods.

The first structure (ConvNet#1) consisted of two convolutional layers with 64 and 16 filters, respectively, with two fully connected (dense) layers with 128 and 8 neurons. It was the lightest architecture considered in this study. The second and third ConvNet structures (ConvNet#2 and ConvNet#3) included three convolutional layers with 256, 128, 64 and 128, 64, 32 filters, respectively, and two fully connected layers were implemented with 128 and 8 neurons. ConvNet#4, which was the deepest architecture in this study, consisted of four convolutional layers (256, 128, 128, and 64 filters) and three fully connected layers (128, 64, and 8 neurons). The filter sizes were considered as 3×3 for all structures, and 0.2 dropout was used for each layer. Pooling was applied as maximum pooling, and 2×2 pooling was considered for each layer except the last convolutional layer of each structure. The pooling was applied as 1×1 in the last convolutional layer of each structure, to not minimize the features extracted by convolutional layers.

Table.1 Data distribution for training, test and validation

Dataset	COVID +ve (class 0)	COVID –ve (class 1)	Total
Training	438	333	771
Testing	43	75	118
Validation	57	60	117

IV. PROPOSED METHODOLOGY

In real life, we always prefer to come up with a medical diagnosis based on multiple medical expert views. The combined opinion of the medical experts helps in reaching a more reliable conclusion. Following the same philosophy, multiple benchmark CNN models have been adopted in our proposed work. They have been trained individually to make independent predictions. Then the models are combined, using a new method of weighted average ensembling technique, to predict a class value. This newly proposed ensembling method is expected to make the prediction more robust. Our proposed work comprises of three pre-trained CNN models—DenseNet201, Resnet50V2 and Inceptionv3. The biggest advantage of Dense Convolution Network or DenseNet, shown in Fig. 3, is that it requires comparatively fewer parameters than similar types of traditional CNN. An additional reason to choose DenseNet is that each layer takes the feature maps of all preceding layers as inputs. This helps to strengthen feature propagation and encourages feature reuse.

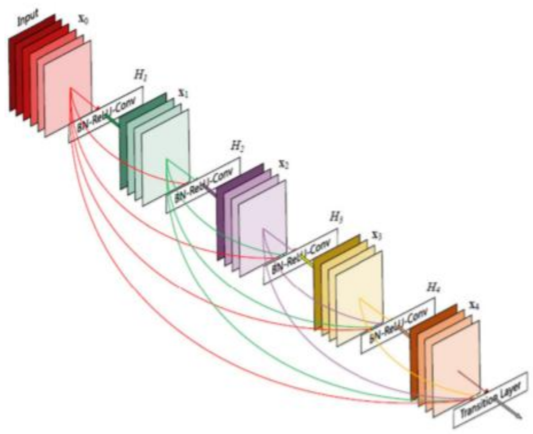

Fig 3 DenseNet architecture

PROPOSED APPROACH ARCHITECTURE

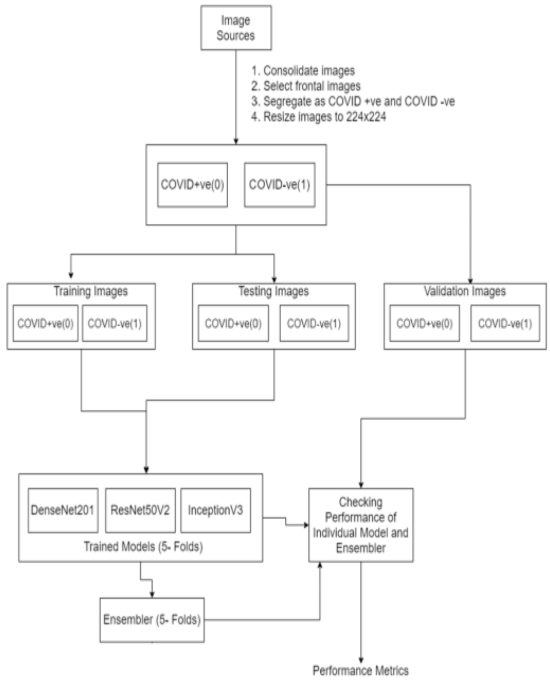

Fig.4 Proposed approach architecture

V. CONCLUSION

Detecting COVID-19 from chest x-rays is of great importance to both clinicians and patients to reduce diagnosis time and financial costs. Artificial intelligence and deep study can detect snapshots of the tasks being taught. In this test, several experiments were conducted for high-resolution detection of COVID-19 in chest X-ray images using ConvNets. It took several combinations of COVID-19/Normal, COVID-19/ Pneumonia, and COVID-19/Pneumonia/Normal for classification. Various photographic dimensions, distinct network architectures, sophisticated networks and machine learning models were implemented, and the use of images and statistical data was evaluated. When considering the range of images in the database and the time of COVID-19 detection (mean test time = zero .03 sec/image) using ConvNets, it can be suggested that the architectures considered underestimate the computational scale. Cost with high performance.

REFERENCES

[1] World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. https://covid19.who.int.

[2] Apostolopoulos, I. D.; Mpesiana, T. Covid-19: Automatic Detection from X-Ray Images Utilizing Transfer Learning with Convolutional Neural Networks. Phys. Eng. Sci. Med. 2020, 43, 635–640.

[3] Rubin, G. D.; Ryerson, C. J.; Haramati, L. B.; et al. The Role of Chest Imaging in Patient Management during the COVID- 19 Pandemic: A Multinational Consensus Statement from the Fleischner Society [published online ahead of print, 2020 Apr 7]. Chest. 2020, S0012-3692, 30673–30675. doi:10.1016/j. chest.2020.04.003.

[4] Ozsahin, I.; Sekeroglu, B.; Mok, G. S. P. The Use of Back Propagation Neural Networks and 18F-Florbetapir PET for Early Detection of Alzheimer's Disease Using Alzheimer's Disease Neuroimaging Initiative Database. PLoS One. 2019, 14, e0226577

[5] Chouhan V, Singh S, Khamparia A, Gupta D, Tiwari P, Moreira C, Damaeviuus R, Albuquerque V (2020) A novel transfer learning-based approach for pneumonia detection in chest X-ray images. Appl Sci 10:559.

[6] Rajpurkar P, Irvin J, Zhu K, Yang B, Mehta H, Duan T, Ding D, Bagul A, Langlotz C, Shpanskaya K, et al (2017) Chexnet: radiologist-level pneumonia detection on chest x-rays with deep learning. arXiv preprint arXiv:1711.05225
[7] Andre E, Brett K, Roberto A et al (2017) Dermatologist-level classifcation of skin cancer with deep neural networks. Nature 542(7639):115–118

[8] Grewal M, Srivastava MM, Kumar P, Varadarajan S (2017) Radiologist level accuracy using deep learning for hemorrhage detection in CT scans. arXiv:1710.04934.