International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 3 ǁ 2022 ǁ PP. 41-44

Radio Imaging Based Covid-19 Detection Techniques using Deep Learning: A Review

Sukhwinder Bir[#1], Vijay Dhir[*2]
[#]*Research Scholar UIET, Sant Baba Bhag Singh Univ., *Professor CSE UIET, Sant Baba Bhag Singh Univ.*

Abstract— *Since the WHO (World Health Organization) declared the Corona virus outbreak in early 2020, the spread of the sickness, which is thought to have originated in Wuhan, China, has shook the whole world. The virus's most scary aspect is how quickly it spreads and how many mutations there are. Even now, there is no consensus on the exact therapy and diagnostic technique. Preventing the spread of illness necessitates a quick and readily available remedy. The findings of the RT-PCR test take a long time to get back. For the findings confirmation of radio imaging-based tests, an expert opinion is required, which is mostly dependent on topic competence. Researchers are currently attempting to deploy various machine learning methods for illness detection as a result of the introduction of deep learning techniques and their relevance in numerous industrial and medical applications*

Keywords— **CNN, RT-PCR, CT, CXR, VGG-16, Resnet50**

Date of Submission: 05-03-2022 Date of acceptance: 21-03-2022

I. INTRODUCTION

The Covid -19 pandemic, which is caused by the SARS (severe acute respiratory syndrome) virus and is believed to have begun in Wuhan, China, has spread to over 200 countries and has been declared a public health emergency at the start of 2020. Through September 4, 2021, there have been 219,828,144 confirmed cases and 4,553,811 fatalities. (Wikipedia). The covid -19 virus's mutations add to the challenge's complexity. Many vaccines developed by agencies are ineffective against all kinds. [1] In January 2020, the World Health Organization declared the COVID -19 outbreaks a "public health emergency." [2]. The major symptoms of Covid -19 are fever and cough, however there are also non-specific symptoms including fatigue, headache, and dyspnea. [5,6]. The infection can lead to pneumonia and respiratory problems, which can lead to mortality in extreme instances [4]. The disease's transmissive feature can be used to quantify the diseases tranquilly.

Medical professionals are under constant pressure to diagnose disease at an early stage, at a high rate, and in a short period of time. The Real-Time Polymerase Chain Reaction Test [RT-PCR] is the only test that is both authorised and reliable. This test, on the other hand, has a high rate of false negatives and takes a long time to complete. Individuals that are infected have the capacity to infect others [3]. As a result, the first and most crucial step is to test positive individuals as soon as possible using a variety of rapid procedures in order to prevent infection spread and provide appropriate treatment. Some visual markers on patients' lungs, such as ground glass opacities, have been observed to identify covid -19 patients from non-covid -19 persons [4]. As a consequence, chest CT image analysis can be used to diagnose COVID-19 infection as an alternate technique.

The use of chest imaging to diagnose disease has a number of advantages. It's easy to use and almost widely available in hospitals, or at least in big cities. Deep learning-based approaches can recognise specific traits automatically, revolutionising the area of medical image analysis. Because in this case these solutions do not rely on handcrafted pieces. Hence The algorithm has the ability to learn from data. A chest CT scan has also been reported to have significantly greater sensitivity than an RT-PCR test [8]. It was necessary to develop a method for detecting Covid -19 infection using CT scans. The only disadvantage of Covid-19 is the limited number of datasets accessible for diagnosis [7].

II. TYPES OF DEEP LEARNING MODELS

Artificial neural networks (ANNs), also known as layered ANNs, are used to develop deep learning models that imitate the operation of the human brain. There are two types of models in this collection. Pre-trained and non-pre-trained . With the use of public databases, pre-trained models are developed and then applied to the issue at hand. Pre-trained networks, in technical terms, use weights determined from the execution of comparable databases in the past. Non-pre-trained categories, on the other hand, start at the beginning of the learning process. The absence of overfitting and bias concerns is one of the advantages of a pre-trained network. We shall investigate two CNN-based models in this research.

A. Single Deep learning methods
B. Ensemble learning methods

Standardised models like VGG-16 ResNet exceptions and others are used with little or no change when employing a single learning strategy, however ensemble learning is predicated on the concept that a single deep learning model is insufficient for extracting features for image analysis. After making such an effect on their thoughts, the researchers sought to combine the two models or one with traditional machine learning algorithm to create ensemble learning, a hybrid model

A. Single Deep learning methods

CORONET is a CNN-based framework for detecting the presence of covid-19 developed by Asif et al. It makes use of the Xception model, which is a descendant of the inception model and has 71 layers and is pre-trained on the Imagenet database. This model use depth-wise separable convolution to decrease processing needs while conducting operations. Flatten and dropout layers are added at the end of the model to improve it even further. Below is a brief summary of the model.

Table 1
SINGLE DEEP LEARNING METHODS

Layer Type	Output Shape	Param
Xception (Model)	5 × 5 × 2048	20,861,480
flatten (Flatten)	51,200	0
dropout (Dropout)	51,200	0
dense (Dense)	256 13,107,456	1028
dense_1 (Dense)	4	
Total Parameters:	33,969,964	
Trainable Parameters:	33,915,436	
Non-trainable Parameters:	54,528	

For training purposes, the model is trained in four distinct types of situations with two, three, and four different outcome categories. All-time favourite parameters confusion matrix, accuracy, precision, recall, and F-measure are recorded in Keras using Adam optimizer, learning rate of 0.0009, batch size of 10, and epochs 80 for assessment purposes. The model's total accuracy is 90.21 percent.

2020, Javier et al. has attempted to draw researchers' attention to the problem that many testing procedures now available are either time consuming or intrusive. The author has also attempted to demonstrate that even image-based analysis methodologies require experts for decision-making for illness confirmation, which is mostly dependent on the competence of the field expert because the pictures of Pneumonia and Covid -19 radio images are almost identical. However, since the introduction of deep learning-based approaches, picture categorization has become more faster and easier

The author's categorization process is entirely based on convolutional networks (VGG-16). The histogram equalisation approach, which is widely recognised for its contrast stretching capabilities, has demonstrated promising results when used as a pre-processing step. For performance evaluation, the results with histogram equalisation and without histogram equalisation are compared. The training and testing datasets are split 80:20 according to the golden rule. Specificity, precision, sensitivity, and F1-Score are the performance evaluation metrics. The model has a high specificity value, which is a clear sign of a low likelihood of false-positive events The confusion matrix is used to determine these parameters. The numerical findings for these characteristics demonstrate that the Covid-19 and Pneumonia instances are significantly different. Finally, the ROC (Receiver operating characteristics) curve has demonstrated acceptable classification reliability.

Fasttrack Covid-19 classification network (FCO NET) was introduced by Ko et al. (2020) as a simple deep learning framework for categorising covid-19 Pneumonia, other pneumonia, and non-pneumonia illnesses The model was developed as a backbone employing transfer learning techniques with state-of-the-art pertained models VGG-16, Resnet-50, and Inception v3 as a backbone. With a score of 96.97 percent, Resnet-50 was the most accurate of these models. The measures used to evaluate performance were sensitivity, specificity, and accuracy. The Confusion matrix provides all of these variables. In addition to these parameters, the Receiver Operating Characteristics (ROC) and Area Under Curve (AUC) are shown. The p value, which represents the smallest level of significant difference in the resultant classes, is calculated using ANOVA (Methodology of

Variables), which is a rather rare analysis identified in classification literature and applied by the author to address the problem of overfitting.

B. Ens1mble Learning methods

Loey et al (2020) proposed a method for overcoming dataset size limitations. The amount of datasets available is currently limited, and every machine learning method need as many sample points as feasible in order for the computer to learn every feature that could exist in the real world. GAN (Generative adversarial networks) is a revolutionary method of increasing data size that is used to create fresh images that might be considered fraudulent in order to enhance the size of sample point datasets. GANs are divided into two types: generating networks and discriminative networks. A rudimentary convolutional model (Alexnet & Googlenet) is used to categorise the photos once the dataset has grown in size. The level of performance has improved noticeably. When compared to a smaller dataset, the larger dataset outperformed the smaller one. To evaluate performance, a confusion matrix was used to determine validation and testing accuracy. The four classes used in the study were Covid-19, Nomal, Pneumonia Bacterial, and Pneumonia Viral

Situala et al. (2020) developed a novel model under the ensemble learning umbrella in which a standardised pre-trained deep learning model called VGG-16 was utilised in conjunction with an attention module for two reasons:

1. By having a tiny kernel size, it was able to encapsulate low-level features.
2. It was more capable of extracting features for categorization reasons.'

Attention module, convolution module, fully linked layer, and soft max layer were the four models suggested. Using the approach presented by Woo et al., the attention module was employed to capture the spatial connection of CXR visual characteristics. The result of max pooling and average pooling of the input were concatenated in this model. The output of the concatenation was then convoluted using a 7x7 filter and the sigmoid function. A mathematical equation can be used to explain the whole process.

$$M_s(F)=\text{Sigmoid}(f^{7\times7}[[F^s_{avg}: F^s_{max}])\ldots\ldots\ldots\ldots i$$

Where F^s_{max} and F^s_{avg} are average pooling and max pooling tensor on the input tensor F.
The brief description of the model is given in the following table

TABLE 2
ENSEMBLE LEARNING METHOD

Layer Type	Output Shape
VGG-16 (Model)	9 × 9 × 512
Lamda layer (Avg pooling)	9 × 9 × 1
Lamda layer (Max pooling)	9 × 9 × 1
Concat layer	9 × 9 × 2
Conv layer	9 × 9 × 1
Concat layer	9 × 9 × 513
Flatten	41,553
Dropout	41,553
Dense	256
Dense	4
Total Parameters:	18,273,957
Trainable Parameters:	18,273,957
Non-trainable Parameters:	0

The experiments employed three publicly accessible data sets, and the model achieved an overall accuracy of 75.98 in the ensemble category, which was regarded a considerable improvement above the previous ensemble models. The conclusion matrix and accuracy recall fscore were utilised as usual for performance evaluation. Three separate data sets were used to create the matrix. Using the all-time hit golden ratio of 7:3, the data was separated into training and test groups. Keras was used to put the model together

Dilbag singh et al (2020) proposed a unique approach based on multi objective differential evolution to overcome the hyperparameter tuning problem, which is one of CNN's major flaws. The most significant hyper parameters are padding, stride, learning rate, activation function, batch size, and epochs. The multi objective function proposed in this study emphasises sensitivity and specificity. Differential evolution was made possible

by Darwin's hypothesis. Positive attributes are passed down from generation to generation, whereas negative features fade away with time, according to the Darwin theory. The approach discussed in this study is made up of three parts. All of these procedures, including mutation, crossover, and selection, are possible. Once again, the confusion matrix is employed to assess performance. Many other combinations of training and test data are used for performance analysis, such as 20:80, 30:70, 40:60, and so on. The image dataset includes CT scan images of healthy individuals, patients with mild illnesses, and patients with severe infections. In the photos exhibiting infections, ground glass opacities may be observed in the lobes, enlarged bronchi, and blood vessels of the lungs. For quantitative analysis, Receiver operating characteristics, accuracy, F-measure, sensitivity, and Kappa statistics are used in addition to the confusion matrix.

Sethi et al. 2020 propose a new technique that comes under the umbrella of ensemble learning. For classification, the proposed model employs a simple convolutional model enhanced with SVM (support vector machine). The prosed model takes use of the deep characteristics identified at each layer of the basic models, which are supplied into SVM as input. For feature extraction, the author employed 13 basic models, although classification was done by an SVM machine in the end. Data sets are obtained from Kaggle and Github, according to the author. The dataset is separated into three categories: Nomal, Covid, and Pneumonia (bacterial and viral) and is divided into an 80:20 ratio for training and testing. The combination of Resnet50 and SVM produced the maximum accuracy of 95.33 percent, with a false positive ratio (FPR) of 2.33 percent.

III. CONCLUSIONS

The RT-PCR test is the most frequently accepted nowadays. However, in order to administer the test, kits must be readily available. Furthermore, a quick diagnosis is not possible due to the time it takes. Radiology-based methods can be considered an alternative for two reasons: first, they give quick findings, and second, they are widely available. The unanimous support of medical experts for these methods is sufficient to establish their credibility. In the early stages of the condition, the lungs' susceptibility to sickness presents itself. Technical advancements in image-based analytic methodologies have shown promising results, making it easier to discriminate infected from non-infectious patients with high precision. However, due to the growing size of the database, there is still much too much opportunity for research in the field of disease classification

REFERENCES

[1] Delphine Planas, David Veyer, Artem Baidaliuk, (2021) “Reduced sensitivity of SARS-CoV-2 variant Delta to antibody neutralization” https://doi.org/10.1038/s41586-021-03777-9, vol 596, pp 276-280.

[2] Stiuala Chiranjibi,Hossain MB(2020), “Attention based VGG-16 mode for COVID-19 chest X-ray image classification”, Springer, pp 2850-2863.

[3] Singh D, Kumar V, Kaur M (2020), “Classification of COVID-19 patients from chest CT images using multi-objective differential evolution–based convolutional neural networks”. Eur J Clin Microbiol Infect Dis 39:1379–1389.

[4] Khan AI, Shah JL, Bhat MM (2020), “Coronet: a deep neural network for detection and diagnosis of COVID-19 from chest X-ray images”. Elsevier, Computer Methods and Programs in Biomed vol.196, pp 1-10.

[5] Zhang Y (2020) “The epidemiological characteristics of an outbreak of 2019 novel coronavirus (COVID-19) in China”, CCDC. Zhonghualiu xing bing xue za zhi Zhonghua liuxingbingxue zazhi 41(2):145

[6] Xie Z (2020), “ Pay attention to SARS-CoV-2 infection in children”. Pediatr Invest 4(1):1–4

[7] D. Shen, G. Wu, H.I Suk, “Deep learning in medical image analysis”, Annu. Rev.Biomed. Eng. 19 (2017 Jun 21) 221–248

[8] Fang Y, Zhang H, Xu Y, Xie J, Pang P, Ji W (2020), “CT manifestations of two cases of 2019 novel coronavirus (2019-nCoV) pneumonia”. Radiology 295(1):208–209

[9] Loey M, Smarandache F, M Khalifa NE (2020), “ Within the lack of chest covid-19 x-ray dataset: a novel detection model based on GAN and deep transfer learning”. Symmetry 12(4):651, pp 1-19.

[10] Ko H, Chung H, Kang WS, Kim KW, Shin Y, Kang SJ, Lee JH, Kim YJ, Kim NY, Jung H et al (2020), “Covid-19 pneumonia diagnosis using a simple 2d deep learning framework with a single chest ct image: model development and validation”. J Med Internet Res 22(6):e19,5

[11] Civit-Masot, Javier, Francisco Luna-Perejón, “Manuel Domínguez Morales, and Anton Civit. "Deep learning system for COVID-19 diagnosis aid using X-ray pulmonary images." Applied Sciences 10, no. 13 (2020): 4640.

[12] P.K. Sethy, S.K. Behera, P.K. Ratha, P. Biswas, “Detection of coronavirus disease (COVID-19) based on deep features and support vector machine, Int”. J. Math. Eng. Mana. Sci. 5 (4) (2020) 643–651, https://doi.org/10.33889/ IJMEMS.2020.5.4.052 222