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COVID Disease Detection Using Deep Learning Techniques

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ABSTRACT: Covid-19 is a common spreading disease, and till now, not a single country can prepare a vaccine for COVID-19. A clinical study of COVID-19 infected patients has shown that these types of patients are mostly infected from a lung infection after coming in contact with this disease. Chest x-ray (i.e., radiography) and chest Computed tomography (CT) are a more effective imaging technique for diagnosing lunge related problems. Still, a substantial chest x-ray is a lower cost process in comparison to chest CT. Deep learning is the most successful technique of machine learning, which provides useful analysis to study a large amount of chest x-ray images that can critically impact on screening of Covid-19. According to the findings, deep learning-based models have an extraordinary capacity to offer accurate and efficient system for the detection and diagnosis of COVID-19, the use of which in the processing of modalities would lead to a significant increase in sensitivity and specificity values. It was classified with the ResNet50 model, which is convolutional neural network architecture in Covid-19 detection using chest x-ray images. The experimental results are encouraging in terms of the use of computer-aided in the field of pathology. It can also be used in situations where the possibilities and RT-PCR tests are insufficient.

KEYWORDS: Covid-19,Deep learning,Chest X-Ray,RT-PCR,ResNet50.

I. INTRODUCTION

With the outbreak of an unknown disease in late 2019 in China, some people became infected with the disease in a local market. The disease was completely unknown at first, but specialists diagnosed its symptoms as similar to those of corona virus infection and flu. The specific cause of this widespread disease was initially unknown, but after the laboratory examination and analysis of positive sputum by real-time polymerase chain reaction (PCR) test, the viral infection was confirmed and eventually named “COVID-19” upon the recommendation of the World Health Organization (WHO). Over a short period, the COVID-19 epidemic crossed geographical boundaries with a devastating effect on the health, economy, and welfare of the global population . Based on the Worldometers (worldometers.info) statistics, until January 5, 2021, more than 86 million people worldwide contracted COVID-19, of whom more than 1,870,000 people died officially due to the disease. The early detection of COVID-19 is essential not only for patient care but also for public health by ensuring the patients’ isolation and controlling the pandemic . Due to the novelty of the disease, ways to fight it were not known in the early days, but researchers considered screening and rapid diagnosis of infected patients and their separation from the community of healthy people as an important measure. The clinical features of COVID-19 include respiratory symptoms, fever, cough, dyspnea, and pneumonia. However, these symptoms do not always indicate COVID-19 and are observed in many cases of pneumonia, leading to diagnostic problems for physicians.

While the RT-PCR test is the gold standard for diagnosing COVID-19, it has limiting aspects with certain features that make it difficult to diagnose the disease. RT-PCR is a very time-consuming, complex, costly, and manual process. One of the drawbacks of this method is the need for a laboratory kit, the provision of which is difficult or even impossible for many countries during crises and epidemics. Like all diagnostic and laboratory methods in healthcare systems, this method is not error-free and is biased. It requires an expert laboratory technician to sample the nasal and throat mucosa which is a painful method, and this is why many people refuse to undergo nasal swap sampling. More importantly, many studies indicated the low sensitivity of the RT-PCR test; several studies have reported the sensitivity of this diagnostic method to be 30% to 60%, indicating a decrease in the accuracy of the diagnosis of COVID-19 in many cases. Some studies also pointed to its false-negative rate and contradictory results.One of the most important ways to diagnose COVID-19 is to use radiological images, including X-ray and computed tomography (CT) scan.

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Chest imaging is a quick and easy procedure recommended by medical and health protocols and has been mentioned in several texts as the first tool in screening during epidemics.

Compared to RT-PCR, CT scan images have a high sensitivity in diagnosing and detecting cases with COVID-19; however, their specificity is low. This means that CT scan is more accurate in cases of COVID-19, but less accurate in cases of nonviral pneumonia. A study conducted on the diagnosis of patients in Wuhan, China, showed that consolidation and ground-glass opacities (GGO) were not observed in CT scan imaging in 14% of the images, meaning that 14% of the definitive cases of COVID-19 were misdiagnosed as completely healthy based on their CT scan tests. Out of 18 patients with COVID-19 who had GGO with consolidation, only 12 had GGO and, as a result, no consolidation or disease was observed. Despite the presence of consolidation without the advent of GGO in many cases, it was difficult and almost impossible to detect COVID-19. All these cases demonstrated a defect in the diagnosis of COVID-19 using CT scans. In this study, chest X-ray images created using more thanone data set were studied. Due to the small dataset, imageaugmentation techniques were used. Classification of Covid-19cases was performed using the ResNet-50 model based on pretrainedconvolutional neural networks on chest x-ray images.

II. LITERATURESURVEY

Abdullah Aman Khan, Sidra Shafiq, Rajesh Kumar, Jay Kumar, Amin Ulhaq[1] presents the Hybrid 3D Deep Neural Network model (H3DNN) to classify chest CT imaging. The model is developed by ensembling the Inflated inception (I3D) and 3D ResNet 50 to build a common architecture for capturing the Spatio-temporal dimension including the inception block. Unlike previous approaches, H3DNN can semantically generate deep 3D samples with permutation-invariance to improve network accuracy. The main contributions of our work are given as follows: We propose an automated 3D deep learning model(H3DNN) to classify 3D chest CT imaging to screenout infected patients. Our approach can easily diagnose the early stage ofCOVID-19 patients by considering Spatio-temporal features and constructing 3D filters. We conducted extensive experiments on two available datasets. The results of the experiments boldly show the significance of H3DNN.The proposed model automatically and effectively detects the COVID-19 patients at a low cost in terms of annotations of CT images.

Zehrakarhan, Faut Akal[2] presented to the method to detect covidpositive cases early to prevent further spread of the outbreak using CT images. In the diagnostic phase, radiological images of the chest are determinative as well as the RT-PCR (Reverse Transcription-Polymerase Chain Reaction) test. It was classified with the ResNet50 model, which is a convolutional neural network architecture in Covid-19 detection using chest x-ray images. Chest X-Ray image analysis can be done and infected individuals can be identified thanks to artificial intelligence quickly.Given that the classification accuracy is calculated with a high accuracy rate of 94.5%, it can help in clinical practice. Also, although the data set is small, the results are encouraging in terms of the use of computer-aided in the field of pathology. It can also be used in situations where the possibilities are insufficient (RT-PCR test, doctor, radiologist).

EmrahIrmark[3] presented a novel, powerful and robust Convolutional Neural Network (CNN) model is designed and roposed for the detection of COVID-19 disease using publicly available datasets. This model is used to decide whether a given chest X-ray image of a patient has COVID-19 or not with an accuracy of 99.20%. Experimental results on clinical datasets show the effectiveness of the proposed model. It is believed that study proposed in this research paper can be used in practice to help the physicians for diagnosing the COVID-19 disease.

Talha Anwar, SeemabZakir[4] presented thereverse transcription-polymerase chain reaction (RT-PCR) test is used to detect covid detection. Because of colossal demand; PCR kits are under shortage, and to overcome this; radiographic techniques such as X-rays and CT-scan can be used for diagnostic purpose. In this model, deep learning technology is used to diagnose COVID-19 in subjects through chest CT-scan. EfficientNet deep learning architecture is used for timely and accurate detection of coronavirus with an accuracy 0.897, F1 score 0.896, and AUC 0.895. Three different learning rate strategies are used, such as reducing the learning rate when model performance stops increasing (reduce on plateau), cyclic learning rate, and constant learning rate. Reduce on plateau strategy achieved F1-score of 0.9, cyclic learning rate and constant.

Samira Lafraxo, Mohammed El Ansari [5] presented theCoviNet a deep learning network to automatically detect COVID19 presence in chest X-ray images. The suggested architecture is based on an adaptive median filter, histogram equalization, and a convolutional neural network.This model is entirely automated with an end-to- end architecture that does not use any handcrafted method It is trained end-to-end on a publicly available dataset. This model achieved an accuracy of 98.62% for binary classification and 95.77% for multi-class classification. As the early diagnosis

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may limit the spread of the virus, this framework can be used to assist radiologists in the initial diagnosis of COVID19.

SertanSerte, Ali Serener [6], proposed the ResNet-18 deep learning architecture to test the images for early pleural effusion detection. As the idea is to detect the disease before it evolves into pleural effusion, we created separate performance metrics of each disease. The performance results show that ResNet-18 architecture is able to detect pneumonia and tuberculosis the best before they convert into pleural effusion. They also show that the early detection of COVID-19 is the worst of the three. To distinguish between bacterial and viral pneumonia, COVID-19, and pleural effusion diseases, we ran additional experiments. We showed that out of these four, COVID-19 and bacterial pneumonia have the highest detection rate whereas viral pneumonia and pleural effusion have the lowest.

RajarshiBhadra, SubhajitKar[7] proposed model takes less time to be trained and performed satisfactorily in terms of blind test accuracy. The hyper-parameters have been chosen experimentally in the proposed methodology. A dropout rate less than 50% results over-fitting in the training process. Batch size of 10 has been selected as sweetest spot for getting good accuracy. A higher batch size results less training time with less classification accuracy.In this paper, a light weight multi-layered CNN architecture has been proposed to detect and classify CXR images of COVID-19 patients. 10-fold cross validation technique and blind testing have been performed in the proposed methodology to make the system more robust. A blind test accuracy of 99.1% has been obtained by the proposed technique. Therefore, the proposed methodology can be used as a second opinion for medical professionals with their diagnostic prediction of COVID-19.

Papa AbdouKarimKarouDiallo, Yum Ju[8] presented to build up a dataset named K-COVID from a combination of chest X-ray images, an architecture named K-EfficientNet, which uses and extends the EfficientNet Deep learning network architecture. We also implement the concept of progressive resizing as well as data-augmentation and transfer learning that allows us to get a very good accuracy after training. Despite the use of a larger X-Ray images dataset compared with the work done on, our model achieves a level exceeding their results. With automation at the expert level, we hope that this technology can participate greatly in the delivery against the COVID-19 pandemic and believe that improvement with a larger database would be even better.

Saul Calderon-Ramirez, RaghavendraGiri, Shengxiang Yang, ArmaghanMoemeni, Mario Umana David Elizondo, Jordina Torrents-Barrena, Migu A. Molina-Cabello [9] proposed and tested the use of a novel semi-supervised learning framework based on the recently proposed Mix Match technique. Semi-supervised deep learning makes use of more widely available unlabelled data, which can help to boost the accuracy of these systems. As a contribution in this work, proposed the usage of the semi-supervised accuracy boost coefficient, to measure model scalability under different proportions of evaluation using labelled and unlabelled data. With the tested prototypical dataset (which we warned about the fact that it is still not of acceptable quality to be considered for real-world clinical use given its age and race biases), a significant increase in accuracy is achieved when the labelled/unlabelled data coefficient is set to a low value.For evaluating the system scalability in different labelled/evaluation data scenarios, we proposed the usage of the coefficient. As expected, our tests revealed an important accuracy decrease as el decreases, making the usage of semi-supervised deep learning more attractive in such setting.

AsmaChanna, Nirvana Popescu, Najeeb Ur Rehman Malik [10] provides a great insight to early diagnosis and tracking the condition of COVID-19 patients. In this study we used deep learning CNN technique on chest X-ray images of patients and classified them into two classes of patients with and without COVID-19. The accuracy we obtained is 91.67%. After the positive diagnosis of COVID-19 patients, we aimed to track the progression of disease which may help healthcare professionals work on the correct dynamics and treatment of patients. This research also proposed classifier to track the survival rate of COVID-19 patients which also provides good result with 100% accuracy. This study also concluded that till now this virus has affected more males than females of age around 50-60 years. This research addressed the current problems faced by healthcare professionals in tackling the COVID-19 epidemic.

Ahmed MabroukFangoh, SaharSelim[11] proposed CNN-XGB model produces satisfying results given the materials and time allocated for the experiments, but more testing and tuning is definitely required before such a model could be used for real-world applications. The F1 score for the 2 and 3 class experiments could be improved. The results of the DarkCovidNet model are peculiar, which may possibly be attributed to overtuning the model to the validation set, or simply an error on the part of reimplementation. The results acquired from these sets of experiments show promising possibilities with the use of this application in the field of early COVID-19 screening.Authors and Affiliations The template is designed so that author affiliations are not repeated each time for multiple authors of the

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Shay E. Snyder, GhaithHysari[12] presented the Deep learning methods have become popular in academic studies by processing multi-layered images in one go and by defining manually entered parameters in machine learning. This popularity reflected positively on limited health datasets. In this study, it was aimed to detect the disease of people whose x-rays were taken for suspected COVID-19. In such COVID-19 studies, a binary classification has generally been made. The data set includes chest x-rays of patients with COVID-19, viral pneumonia, and healthy patients. Before the classification process, the data augmentation method was applied to the data set. These three groups have been classified through multi-class classification deep learning models.

Areej A. Wahab Ahmed Musleh, Ashraf Tunis Maghari[13] presented the CheXNet algorithm which is more efficient than expert x-ray specialist. It consists of 121 layer convolutional neural network which is trained on 14 ChestX-ray.In this paper proposed CNN model, which shows the equivalent of the highest score for the accuracy of a specialized chest radiologist, represent a very effective examination tool for the rapid diagnosis of many infectious diseases such as the Covid-19 epidemic that do not require the introduction of a radiologist or physical examinations. We are almost certain that it is possible for the proposed CNN model which shows the equivalent of the highest score for the accuracy of a specialized chest radiologist.

FianYulioSantoso, HindriyantoDwiPurnomo[14] presented, a modification of deep neural network based on Xception model is used for COVID-19 detection based on the chest X-ray images. The proposed model implements two stacks of two dense layers and batch normalization. The layers addition is used to avoid overfitting of the proposed model. The performance of the proposed model is compared to Resnet50, InceptionV3 and Xception. The experiment result shows that the proposed model has better performance than the other models used in the research. However, its computational time is higher than the other models used in the research.The experiment result reveals that, the proposed has better performance in most cases compare to the other model used in this research. It has higher acuracy and lower loss in both training and validation data. The model is able to identify the normal, pneumonia and pneumonia caused by COVID-19 with higher accuracy than the other methods used in the experiments. However, the layes addition leads to longer training time.

Md. Jahid Hassan, Md. ShahinAlom, Md. Shikhar Ali [15] presented toclassified an X-ray image as COVID-19, pneumonia and normal. X-ray machines are widely available and provide images for quickly diagnosis. The segmentation model will activate only when the classification model classifies an X-ray image as COVID-19 or pneumonia. The recognizing of COVID-19 and pneumonia from X-ray images with other Xray images is very challenging because of the high variation in infection characteristics, and low intensity contrast between infections and normal tissues. The affected area has been segmented properly which vastly depend on the output of Grad-CAM algorithm. In future we have a great fascination to work with more deep learning algorithms to find out the right affected area and work with more X-ray image class through different algorithm for both classification and segmentation as well as to make API for that.

YashChaudhary, Manan Mehta, Raghav Sharma, Deepak Gupta, AshishKhanna, Joel J. P. C. Rodrigues [16] presented the EfficientNet-B1 for COVID-19 cases detection from Chest X-Ray images. We used the open source COVIDx3 dataset. Our study proves the efficacy of the EfficientNet model on this task. Our results indicate that EfficientNet-B1 has better sensitivity and PPV than many models. It shows better results than the original COVIDNet models, which were specifically generated for this task throughaNeural architecture search algorithm. We are proud of the fact that our model has sensitivity of 100% for the COVID-19 class. This means that our model correctly predicted all the COVID-19 patients in the test set. To the best of our knowledge, EfficientNet-B1 shows best results.

Judith ChrisolitaSangidong, HindriyantoDwiPurnomo, FianYulioSantoso[17] presented the method FJCovNet achieved the highest validation with less time for training compared to Xception, VGG19, and Resnet50 with the same hyperparameter and dataset used for training and testing. This shows that FJCovNet can help the COVID- 19 detection process quickly and accurately if applied in realtime computer applications. FJCovNet can be built inside a computer application installed in Healthcare facilities. Using API, users, in this case, the radiologist or medical personnel, can input the CT-scan images of suspected patients. The images are then inputted to FJCovNet, and the output is the prediction of whether the patient is positive or not.

Md. Foysal, A. B. AowladHossain[18] proposed a deep learning approach for COVID-19 detection from chest CT scan images. An ensemble hard voting model is designed by combining the three independent deep learning models.

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After evaluating the models, it is seen that the overall accuracy of the ensemble model is improved. Finally, we have also compared the performance scores of our proposed method with the recent works that have been done in this area. The proposed approach achieved the prediction accuracy of 96%. Testing the performance of the proposed method with other diverse data is our future plan. It is expected that the proposed models might be useful for clinical applications to detect the COVID-19 cases using CT scan images.

Mohammad MahmudarRahman Khan, ShadmanSakib, Md. Abu BakrSiddique, MadihaChowdhury, ZaidHossian, Anas Aziz, NowrinYsamin[19]presented an alternate quicker option of detecting COVID-19 using deep learning techniques in chest X-ray images. The performances of six deep neural networks (2D CNN, ResNet-50, Inception ResNetV2, Inception V3, DenseNet201, and MobileNetV2) in classifying the chest X-ray dataset have been evaluated. ResNet-50 yielded the best performance with a classification accuracy of 96.91%, closely followed by DenseNet201 and MobileNetV2 with classification accuracies of 96.22% and 95.88%. All three of these pre-trained neural networks scored (AUC = 100%) for detecting the COVID-19 X-ray images. The 11-layered 2-D CNN performed better than the pre-trained InceptionV3 model which has the least classification accuracy of 94.16%. It also scored a higher AUC value than that of InceptionResNetV2 for detecting the COVID-19 X-ray images. Moving forward, further, development can be carried out on the networks to achieve higher accuracies and efficiency in diagnosis of COVID-19 as well as other chest-related diseases.

Shaoping Hu, Yuan Hai, ZhangminigNiu, Yinghui Jiang, Lao Li, Xianglu Xiao, Minhao Wang, EvandroFei Fang, Wade Menpes-Smith, Jun Xia, Hui Ye, Guang Yang [20] In this work, we have presented a novel weakly supervised deep learning framework that is capable of learning to detect and localise lesions on COVID-19 and CAP CT scans from image-level label only. Different from other works, we leverage the representation learning on multiple feature levels and have explained what features can be learned at each level. Conv4 and Conv5, from which the lesions detected also correspond to our clinical findings that the infections usually located in the peripheral lung (95%), mainly in the inferior lobe of the lungs (65%), especially in the posterior segment (51%).We found one limitation of the proposed network is that it is not discriminative enough when it comes to separate the CAP from COVID-19. We suspect this is due to the limited capacity of the backbone CNN that a straightforward way of boosting CNN capacity is to increase the number of feature channels at each level. Another attempt in the future would be employing more advanced backbone architecture, such as Resent and Inception.

III. COMPARITIVEANALYSIS

S.No	Title	Techniques & Mechanism	Parameter Analysis	Tools	Future Work
1	H3DNN:3D Deep Learning Based Detection of Covid-19 Virus Using Lungs Computed Tomography	Hybrid 3D Deep Neural Network model (H3DNN), Artificial intelligence	Accuracy, sensitivity, specificity, F1-score	Keras with a TensorFlow backend.	design a full multimedia system for doctors that can effectively segment and point out the infections caused by the COVID-19 virus.
2	Covid-19 Classification UsingDeap Learning In Chest X-Ray Images	Image Augmentation Techniques, CNN	Confusion Matrix of Covid-19 and Normal (Non-Covid-19) Images	Neural Designer	it can work with larger data sets.
3	A Novel Deep Convolution Neural Network Model for COVID-19 Disease Detection	Learning, medical image Processing, image classification	Accuracy, specifity, Confusion matrix with covid(+) and covid(-)	Matlab R2019a	it can work with larger data sets.
4	Deep Learning Based Diagnosis of COVID-19 using Chest CT-Sacn images	deep learning, classification	Accuracy, Recall, Precision, F1 – score	Matlab	Future work includes training the model on the same dataset used in this paper

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					and test on some other collected dataset.
5	CoviNet: Automated COVID-19 Detection from X-rays using Deap Learning Techniques	deep learning, convolutional neural network, adaptive median filter	Accuracy, sensitivity, specificity, F1-score	Matlab	use larger clinical datasets to better evaluate the effectiveness of our model, and also to work on the segmentation stage
6	Early Pleural effusion detection from respiratory disease including COVID-19 via deep learning	Pleural effusion detection, Tuberculosis detection, pneumonia detection	Chest radiograph, Pneumonia and pleural effusion rate	MATLAB	we investigated a multiclass detection of bacterial and viral pneumonia, COVID-19 and pleural effusion diseases
7	Covid Detection from CXR Scan using Deep Multi-layered CNN	Multi-layered CNN,CXR scan	Cost function,ReLU,Adam optimizer	Tensorflow	The data augmentation using Generative Adversarial Network can be used in future to increase the number of training images for better classification performance
8	Accurate Detection of COVID-19 Using K-EfficientNet Deep Learning Image Classifier and K-COVID-19 Chest X-Ray Images Dataset	K-EfficientNe Deep learningt	Accuracy	TensorFlow/Keras framework	improvement with a larger database
9	Dealing with Scarce Labelled Data:Semi-Supervised Deep Learning With Mix Match for Covid-19 Detection Using Chest X-Ray Images	Semi-supervised Deep Learning	Coefficient	Pytorch/FastAIMixMatch implement-ation	test semi-supervised learning approaches with more data for Covid-19 detection
10	Robust Techniques to Detect COVID-19 Using Chest X-Ray Images	Robust Techniques, CNN,Deeplearning,CXR image	Confusion matrix with age and sex,	Neural Designer	applying this technique in real time clinical data and improving the accuracy
11	Using CNN -XGBoost Deep Network for COVID-19 Detection in Chest X-Ray Images	Convolutional neural network (CNN), Covid-19, Deep learning, Machine learning, Transfer learning, XGBoost	F1 score, DarkCovidNet model	Neural Designer	increased experimentation with hyperparameters and different base models
12	COVID-19 Detection Using Deep Learning Methods	CNN, multi-class classification,	F1 Score, precision, Recall	TensorFlow/Keras framework	the success ratio can be increased by strengthening the data Manipulation Program
13	COVID-19 Detection in X-ray Images Using CNN Algorithm	CNN,ChexNet Algorithm	F1 score, Cross-entropy	MATLAB	Improved interpretation of CNN model
14	A Modified Deep Convolutional Network for COVID-19 Detection Based on Chest X-Ray Images	Modified Deep Convolutional Network	Training and validation accuracy & loss	Tensorflow	Extract the lower loss in both training and validation data

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15	Deep Learning Based Detection and Segmentation of COVID-19 & Pneumonia on Chest X-Ray Image	deep transfer learning, DenseNet103 deep learning computer tomography	Training and validation accuracy & loss	Amazon SageMaker Ground Truth too	great fascination to work with more deep learning algorithms to find out the right affected area and work with more X-ray image
16	Efficient-CovidNet : Deep Learning Based COVID-19 Detection From Chest X-Ray Images	deep learning, CNN	Sensitivity, Positive prediction value	ADAM optimizer with AMSGRAD	improving PPV and sensitivity by training on newly collected data and experimenting the software in real world scenarios
17	Application of Deep Learning for Early Detection of COVID-19 Using CT-Scan Images	FJCovNet, Deep learning, DenseNet121	Training and validation accuracy & loss	keras and tensorflow	improvement with a larger database
18	COVID-19 Detection from Chest CT Images Using Ensemble Deep Convolutional Neural Network	ensemble deep convolutional neural network,	Specificity, sensitivity, recall, precision, F1 score,	keras and tensorflow	Testing the performance of the proposed method with other diverse data is our future plan
19	Automatic Detection of COVID-19 Disease in Chest X-Ray Images Using Deep Neural Networks	2-D CNN, Image Analysis, Transfer learning	Pre processing, augment -ation	Keras / Tensor Flow	Achieve higher accuracies and efficiency in diagnosis of COVID-19 as well as other chest-related diseases.
20	Weakly Supervised Deep Learning for COVID-19 Infection Detection and Classification From CT Images	deep learning, weakly supervision, CNN	Integrated Gradient, summation of the gradients	MATLAB	envisage a large-scale deployment of the developed framework

IV. CONCLUSION

Early diagnosis is essential both for early intervention to the Patient and to prevent the risk of transmission. For this purpose, Chest x-ray images were used obtained from Covid-19 and non-covid-19 patients. These images are classified using the Transfer learning model ResNet-50. Given that the classification Accuracy is calculated with a high accuracy rate of 99.5%, it can Help in clinical practice. Also, although the data set is small, the Results are encouraging in terms of the use of computer-aided in The field of pathology. It can also be used in situations where the possibilities are insufficient (RT-PCR test, doctor, Radiologist).

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