LITERATURE SURVEY of
Detection of COVID-19 using Convolution Neural Network

Paper-1: Detection COVID-19 using Machine Learning from Blood Tests.

https://ieeexplore.ieee.org/document/9447639

Problem addressed: In this paper, they studied the capability of ML models to detect the Covid-19 in early stages using blood samples datasets.

Algorithms Used: Here they used Machine Learning technique with different classifiers such as Random Forest (RF), Support Vector Machine (SVM) and Naive Bayes. The accuracy achieved was 76% for RF, 88% for SVM and 85% for Naive Bayes. SVM classifier achieved the best accuracy. They generated their own dataset which was used in detecting COVID-19. The dataset includes 134 cases from different genders, different ages and separated between positive and negative cases. The dataset contains blood tests which are (CBC, CRP, D-Dimer, S-ferritin, ALT,LDH).

Performances: They used three classifiers with data split percentages 70% training to 30% testing that are mostly used which are Random Forest, SVM and Naive Bayes. SVM has the highest accuracy which is 88% , recall 88%, precision 91% and F-Measure 88%. The second classifier (Random forest) has an accuracy of 76%, recall 76%, precision 74% and F-Measure 75%. While the last classifier (Naive Bayes) has an accuracy of 85%, recall 85%, precision 86% and F-Measure 85% as shown in below table.

	Random Forest	**Naive Bayes**	**SVM**
Accuracy	76%	85%	88%
Recall	76%	85%	88%
Precision	74%	86%	91%
F-Measure	75%	85%	88%

Conclusion: For the Future work, they aim to collect more dataset to get higher accuracy and build a more reliable model. Also, they aim to classify the dataset by using Deep learning techniques such as CNN Model, which will facilitate diagnosing this disease efficiently and in a shorter time, it is expected to provide better results compared to other techniques.

Paper-2: Automatic Detection of COVID-19 Disease in Chest X-Ray Images using Deep Neural Networks.

https://ieeexplore.ieee.org/document/9357034

Problem addressed: In this paper, they have analysed the performances of deep neural networks for COVID-19 detection from the chest X-rays.

Algorithms used: They had analysed the performances of six artificial deep neural networks (2-D CNN, ResNet-50, InceptionResNetV2, InceptionV3, DenseNet201, and MobileNetV2) for COVID-19 detection from the chest X-rays. Their dataset consists of 2905 chest X-rays of three categories: COVID-19 affected (219 cases), Viral Pneumonia affected (1345 cases), and Normal Chest X-rays (1341 cases). Among the implemented neural networks, ResNet-50 demonstrated reasonable performance in classifying different cases.

Performances:

Classification Model	Class	Precision	Sensitivity	Specificity	F1-score	AUC	Accuracy
11 layered 2-D CNN	COVID-19	1.00	0.89	1.00	0.94	1.00	94.85%
	Viral Pneumonia	0.97	0.92	0.98	0.94	0.99	
	NORMAL	0.93	0.99	0.93	0.96	1.00	
ResNet-50	COVID-19	1.00	1.00	1.00	1.00	1.00	96.91%
	Viral Pneumonia	0.98	0.95	0.98	0.96	1.00	
	NORMAL	0.96	0.98	0.96	0.97	1.00	
InceptionResNetV2	COVID-19	1.00	0.89	1.00	0.94	0.89	95.19%
	Viral Pneumonia	0.97	0.93	0.98	0.95	1.00	
	NORMAL	0.93	0.97	0.93	0.95	0.98	
InceptionV3	COVID-19	1.00	1.00	1.00	1.00	1.00	94.16%
	Viral Pneumonia	0.98	0.88	0.99	0.93	0.99	
	NORMAL	0.90	0.99	0.90	0.94	0.99	
DenseNet201	COVID-19	1.00	1.00	1.00	1.00	1.00	96.22%
	Viral Pneumonia	1.00	0.92	1.00	0.96	1.00	
	NORMAL	0.93	1.00	0.93	0.96	1.00	
MobileNetV2	COVID-19	1.00	1.00	1.00	1.00	1.00	95.88%
	Viral Pneumonia	0.95	0.95	0.96	0.95	1.00	
	NORMAL	0.96	0.96	0.96	0.96	1.00	

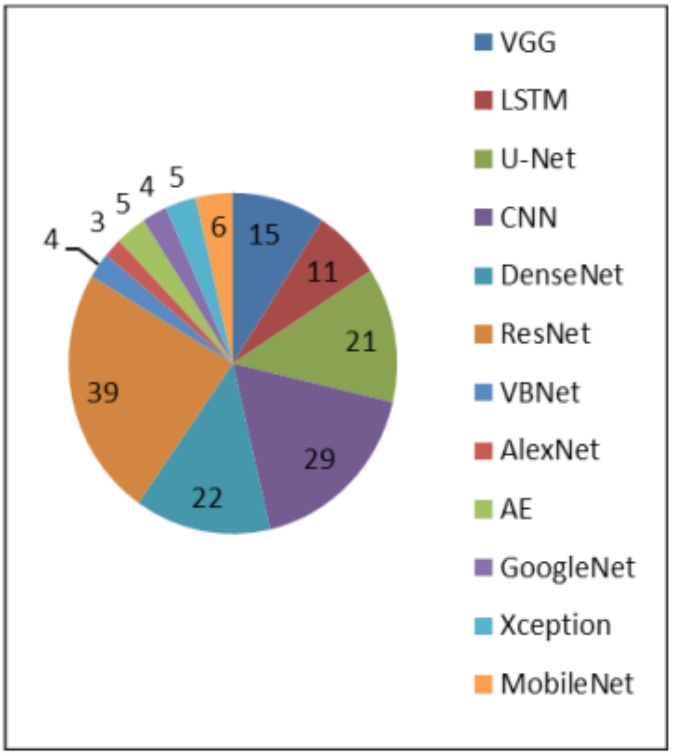
Conclusion: Thus, this research explores an alternate quicker option of detecting COVID-19 using deep learning techniques in chest X-ray images. The performances of six deep neural networks (2D CNN, ResNet-50, Inception ResNetV2, Inception V3, DenseNet201, and MobileNetV2) in classifying the chest X-ray dataset have been evaluated. ResNet-50 yielded the best performance with a classification accuracy of 96.91%, closely followed by DenseNet201.

Paper -3 : Detection of COVID-19 from Medical Images and/ or Symptoms of Patient using Machine Learning Approaches.

https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9336799

Problem addressed: In this paper, a database of X-ray, CT-Scan images from patients with common bacterial pneumonia, confirmed Covid-19 infection, and common cases, were used to automatically detect Coronavirus infection.

Algorithms used: In this study, novel coronavirus infection COVID-19 and techniques for the acquisition of COVID-19 are discussed in detail. The main focus of this review paper is to select the best DL models to detect the segment of the lungs, and predict the COVID-19 patients using DL techniques.



Number of DL Architectures Used for COVID-19 Detection and Prediction Based on Published Papers

Conclusion: COVID-19 is a worldwide epidemic. Wise medical imaging has played an important role in combating COVID-19. The disease is accurately detected by the specialists using X-ray or CT images.In this review paper, a comprehensive review of the accomplished studies of COVID-19 diagnosis was carried out using DL networks. The public datasets available to diagnose and predict COVID- 19 are presented. They strongly feel that, with more public datasets, better DL models can be developed by researchers to detect and predict the COVID19 accurately.

Paper-4:COVID-19 Detection Empowered with Machine Learning and Deep Learning Techniques.

https://www.mdpi.com/2076-3417/11/8/3414

Problem addressed: In this paper, the previous epidemic evidence on Machine Learning (ML) and Deep Learning (DL) techniques encouraged the researchers to play a significant role in detecting COVID-19.

Algorithms used: Remarkable progress has been made in using different ML algorithms applied to medical datasets for detecting different diseases. DL consists of a group of algorithms applied to develop an expert system that can identify problems and yield predictions. In the recent systematic review, the analysis of ML/DL algorithms reported in the literature related to COVID-19 prediction, classification, and detection strategies has been presented. Several researchers have utilised X-ray, CT images.

Performances: The analysis was performed to select appropriate ML/DL techniques to predict and diagnose the virus using radiological and clinical datasets. It is revealed that the highest accuracy of various ML/DL techniques such as CNN, D.N.N, SVM, K-NN, and R.F. Among these deep learning techniques CNN got higher accuracy inorder to detect COVID-19.

It is investigated in the literature that these models achieved greater accuracy in detecting viral pneumonia, bacterial pneumonia, and COVID-19, respectively. ML/DL represents a tremendous innovation in automatic diagnostic classification systems. Therefore, these classifiers present a suitable choice to be employed in diagnosing COVID-19.

Conclusion: The global outbreak of novel coronavirus has affected millions of lives. Fortunately, the current era of advanced technologies with ML/DL techniques has improved various medical aspects of human life and detect chronic and contagious diseases. These ML/DL techniques have achieved astounding performance results in every domain, along with medical research and radiology. However, DL has become dominant in various complicated tasks such as image classification and detection. Being familiar with these models key advantages will assist radiologist's diagnosis research and develop an automated medical diagnosis decision support system for medical health experts. Finally, it can be concluded that ML and DL techniques played a significant role in the prediction, classification, screening, and minimising the spread of the COVID-19 pandemic.

Paper-5 : COVID-19 Detection in X-ray Images using CNN Algorithm.

https://ieeexplore.ieee.org/document/9319286

Problem addressed: In this paper they experimented with applying a convolutional neural networks (CNN) algorithm in a similar way to the mechanism of work in CheXNet algorithm by using a dataset of 550 Chest X-ray images collected from Kaggle website, some of them are infected with Covid-19 virus.

Algorithms used: For example, a less experienced radiologist diagnoses covid with abnormalities. By developing the CheXNet algorithm which is more efficient than an expert X-ray specialist, the diagnostic problem will be solved.CheXNet algorithm consists of a (121) layer convolutional neural network (CNN) which is trained on 14 ChestX-rays.

Performances: The performance of the CheXNet algorithm was compared to the performance of a group of radiologists consisting of four radiologists and the results showed that the CheXNet algorithm exceeded the average performance of the radiologist on the F1-score.It is computed from the accuracy of the test and retrieved, where the accuracy is the number of results Correctly identified positivity divided by the number of all positive outcomes, including those that were not correctly identified, and the recall is the number of correctly identified positive results divided by the number of all samples that should have been identified as positive.

F1 Score (95% Confidence Interval CI)	
Radiologist1	0.383
Radiologist2	0.356
Radiologist3	0.365
Radiologist4	0.442
Radiologist Avg.	0.387
CheXNet	0.435

Conclusion: In conclusion, the results of this unique research show a potential role to quickly identify patients.We are almost certain that it is possible for the proposed CNN model, which shows the equivalent of the highest accuracy, represents 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.

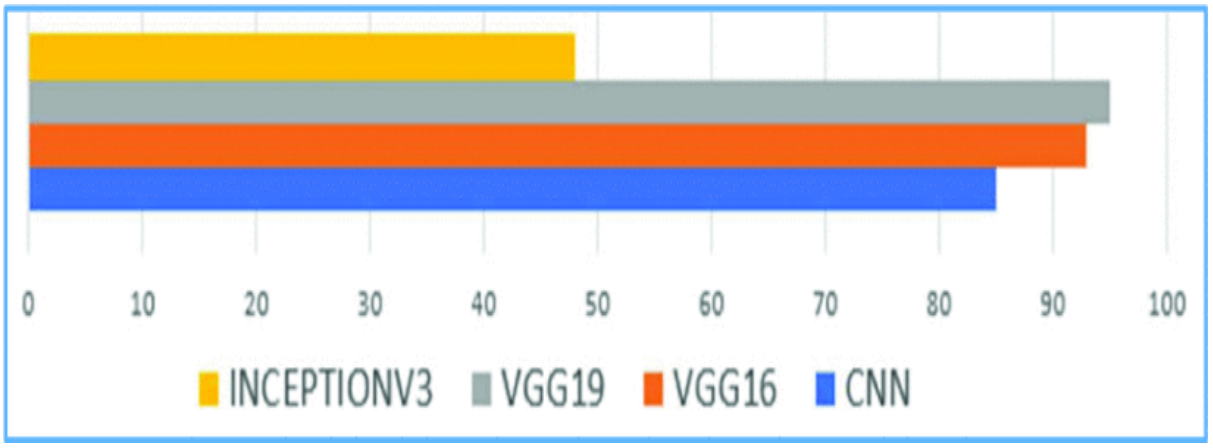
Paper-6: COVID-19 Detection Using Deep Learning Methods.

https://ieeexplore.ieee.org/document/9325626

Problem addressed: 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.

Algorithms used: Here they analysed the performances of some deep learning methods like CNN, VGG16, VGG19, and InceptionV3 that are applied to the chest x-ray dataset.Here InceptionV3,CNN,VGG16 and VGG19 model's accuracies are 48%,85%,93% and 95% respectively.The data set used in the study was created by a few researchers from Qatar and Dhaka universities. The data set includes COVID-19 positive cases, healthy patients, and chest radiographs of viral pneumonia patients.Up to now, a total of 657 chest X-ray images have been examined for the diagnosis of COVID-19 using deep learning methods. This number has been increased with the data augmentation technique.

Performances:



Above shows the comparison of accuracies of deep learning models such as InceptionV3,VGG19,VGG16 and CNN.

Conclusion: According to their study they show that VGG19 is the most successful model that has a 95% accuracy rate. COVID-19 patients, healthy patients, and viral pneumonia cases are classified successfully by the VGG19 model. InceptionV3 is the most unsuccessful method for the dataset.The results of the studies in this paper show the importance of deep learning in combating the COVID-19 outbreak. In future studies, the success ratio can be increased by strengthening the data set. Lung tomography can be used in addition to chest radiographs. By developing different deep learning models, success ratio and performance can be increased.

Paper-7: COVID-19 detection from Xray and CT scans using transfer learning Problem.
https://ieeexplore.ieee.org/document/9430229

Problem addressed: This intensive research has been conducted to find suitable tools for diagnosis and identifying infected people in order to take appropriate action.

Algorithms used: As part of transfer learning approach advocated in their study, they fine-tune two pre-trained models they are DenseNet and InceptionV3 that have been trained on a very large dataset named ImageNet.They empirically demonstrate DenseNet's and InceptionV3 effectiveness on both Xray and CT chest scans. They tuned both pre-trained models, by replacing the last fully-connected layers of the pre-trained model with a new fully-connected layer, and adding a softmax function to the output layer.

Performances:

InceptionV3	92.35%
DenseNet	63.56%
New-DenseNet	85%

Accuracy of recognizing covid-19, normal, pneumonia from x ray chest images

InceptionV3	84.51%
DenseNet	60%
New-DenseNet	95.98%

Accuracy of recognizing covid-19, normal from ct images

Conclusion: In this paper, novel deep learning architectures have been put forward for the purpose of identification of COVID-19 cases from Xray and CT chest scan images. The proposal makes use of a data augmentation step and, next, integrating an extra convolution layer to the DenseNet model.The developed approach outperformed the baseline models, constituted of DenseNet and InceptionV3 models, which demonstrates the feasibility and effectiveness of the proposal.

Paper-8: COVID-19 Detection from X-Ray images using Ensemble Learning with Convolutional Neural Network.

https://assets.researchsquare.com/files/rs-51360/v1_covered.pdf?c=1631838250

Problem addressed: In this paper, they have analysed performances of multiple CNN models that have been adopted and trained individually to make independent predictions. Then the models are combined, using weighted average ensembling technique, to predict a class value.

Algorithms used: This dataset contains CXR images of different patients. They have segregated the images into two broad categories - COVID-19 POSITIVE (referred as class 0) and COVID-19 NEGATIVE (referred as class 1). For Class 0 there are 538 images whereas for Class 1 there are 468 images of Covid negative patients.

Multiple CNN models used are : DenseNet201, Resnet50V2 and Inceptionv3.

They used three common ensemble techniques - Unweighted average approach, weighted average approach (by accuracy) and weighted average approach (by ranked accuracy).

Performances:

Models	**Parameters**	**Validation Accuracy**	**Sensitivity**	**F1-Score**
Individual networks				
DenseNet201	18,325,826	93.6%	92%	94.4%
ResNet50_v2	23,568,898	95.3%	**98%**	95.8%
Inception_v3	21,806,882	94%	93%	94.8%
Ensembled networks				
Unweighted average		94.5%	95%	95.1%
Weighted average (accuracy)[37]		94.5%	95%	95.1%
Weighted average (rank)[37]		95.3%	97%	95.8%
Proposed Approach		**95.7%**	**98%**	**96.2%**

Above shows the comparison of accuracies of various models such as DenseNet201, Resnet50V2 and Inceptionv3. It also shows the accuracies of various ensembling techniques.

Conclusion: According to this paper, the research work has been done to detect the Covid +ve patients from Chest X-Ray images in a simple and inexpensive way. According to their study they show that use of ensembling techniques have generated the best accuracy rate which is 95%. It is believed that this research work along with the GUI interface will help the doctors to detect the affected patients with the help of computer aided analysis, that too within a couple of seconds.

Paper 9: Computer Vision and Radiology for COVID-19 Detection.

https://ieeexplore.ieee.org/document/9154088

Problem Addressed: In this paper, they tried to develop a method that uses radiology, i.e. X-rays for detecting the novel coronavirus. Along with the paper, they also released a dataset for the research community which can be used for further development which is extracted from various medical research hospital facilities treating COVID-19 patients.

Algorithms Used: The proposed solution is inspired by ADADELTA to select a good learning rate value and avoid hit and trial. A batch of 128 images is trained and loss is computed on defined neural network architecture. They used a type of machine learning called Transfer Learning, where a method already generated for a task is replicated as a starting point for a specific task. As the dataset for their study is too small to achieve outstanding results, they adapted a procedure that includes taking an existing neural network that was previously trained on a larger dataset to produce outstanding output. In their work, they selected ResNet-34 and ResNet-50 which were originally trained on the ImageNet data set consisting of 3.2 million images for Image Classification tasks. Both pre-trained architecture models have been re-trained and fine-tuned using transfer learning from the data set obtained.

Performances:

Model	Accuracy	Error Rate
ResNet - 34	66.67%	33.33 %
ResNet - 50	72.38 %	27.62%

Above table represents the accuracy and error rate of both the models developed(i.e ResNet - 34 and ResNet - 50). Compared to ResNet - 34, ResNet - 50 architecture performed better, with an accuracy of 72.38% and with minimum error rate of 27.62%.

Conclusion: In this paper, they have implemented a new method to detect the COVID-19 virus using X-Ray images. The implemented methodology also differentiates the patients suffering from pneumonia and COVID-19 as both have the same symptoms and patients usually get confused between the two. They concluded that, by adding more layers and increasing the number of parameters in Residual Network architecture definitely helps in improving the accuracy of the overall classification.

Paper 10: Deep Learning Techniques for the Real Time Detection of Covid19 and Pneumonia using Chest Radiographs (Chest X-Ray).

https://ieeexplore.ieee.org/document/9535604

Problem Addressed: In the present work, chest radiographs were provided as input to various deep learning CNN architectures for the purpose of feature extraction. After extracting the features, the images were provided as the input to various machine learning classifiers that classify the chest radiographs as Covid-19 positive, pneumonia infection, or healthy scans.

Algorithms Used: They also used a type of machine learning called Transfer Learning, where a method already generated for a task is replicated as a starting point for a specific task. More precisely in this work, different deep learning models such as VGG16, VGG19, and Inception V3 was adopted for the purpose of feature extraction. After extracting the features of these images were passed to distinct machine learning classifiers such as SVM, RF, NN, Naïve Byes AdaBoost etc. for the classification of chest radiograph images as Covid19 infected, pneumonia infected, or a healthy chest radiograph.

Performances:

Model	VGG16				
	AUC	*acc*	*F1*	*pre*	*Recall*
kNN	0.907	0.785	0.793	0.785	0.786
Tree	0.722	0.670	0.665	0.670	0.667
SVM	0.925	0.801	0.802	0.801	0.797
RF	0.884	0.736	0.730	0.736	0.732
NN	0.927	0.821	0.819	0.821	0.819
Naive	0.874	0.740	0.747	0.740	0.743
LR	0.947	**0.832**	0.831	0.832	0.831
AdaBoost	0.737	0.657	0.656	0.657	0.656

Model	VGG19				
	AUC	*acc*	*F1*	*pre*	*Recall*
kNN	0.921	0.795	0.808	0.795	0.797
Tree	0.718	0.651	0.646	0.651	0.648
SVM	0.926	0.816	0.818	0.816	0.810
RF	0.892	0.764	0.758	0.764	0.757
NN	0.929	0.845	0.841	0.845	0.841
Naive	0.879	0.736	0.751	0.736	0.741
LR	0.949	**0.853**	0.852	0.853	0.852
AdaBoost	0.720	0.631	0.637	0.631	0.656

Model	Inception V3				
	AUC	*acc*	*F1*	*pre*	*Recall*
kNN	0.935	0.814	0.813	0.814	0.811
Tree	0.792	0.745	0.743	0.745	0.743
SVM	0.966	0.881	0.881	0.881	0.880
RF	0.926	0.806	0.804	0.806	0.801
NN	0.971	**0.888**	0.887	0.888	0.886
Naive	0.920	0.788	0.805	0.788	0.794
LR	0.972	0.886	0.885	0.886	0.885
AdaBoost	0.783	0.715	0.718	0.715	0.716

It can be observed from the tables below that Inception V3 model along with the neural network classifier gives the highest accuracy of 88.8%. This indicates that whenever a new chest a radiograph will be fed as input to Inception V3 model and neural network classifier, it classifies the chest radiograph as Covid19 infected, pneumonia infected or a healthy radiograph with 88.8% correct prediction.

Conclusion: The results prove that whenever a new image is fed to the model, it can verify that images as of Covid-19 positive, normal, or pneumonia-infected patient with an accuracy of 88.8%. However, these models cannot be directly implemented. They require the proper clinical diagnosis. In future work, they stated that adding more images to the dataset can increase the accuracy. Also, the current dataset may be applied to various deep learning models to enhance the results for the detection of Covid-19 infections.