COVID-19 Detection Using X-Ray Images

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ABSTRACT

The novel coronavirus (COVID-19), known as SARS-CoV-2 previously known as 2019-nCoV causes an illness which affects the respiratory system mainly. It has caused a huge impact on the lives of human lives, health and global economy. The critical problem the world is facing apart from the invention of a vaccine is to detect the presence of coronavirus in the human body in the early stage and prevent the situation from getting worse. To detect the presence of coronavirus the need of tools for diagnosis increased at the fast pace. Recent studies and radiologists specify that the physical examination of the body shows the chest radiographs were found abnormal. Studies also state that chest X-Rays are insensitive in the early stages of the disease. Further if quarantined the patient's X-Rays often reveals changes in the lungs. So, the above findings could be a green signal to make advancement in the field of computer vision, machine learning and deep learning as X-Ray images could help to detect the presence of Coronavirus. Computer Vision is a scientific field which completely focuses on how computers gain a high level of understanding from digitally created images and videos. Computer based analysis for the images have been an issue in the field of medical image analysis. Recent advancement in the field of machine learning and especially deep

learning helps to identify and classify patterns in medical images. The proposed model is built keeping in mind to provide accurate results whether a person is Covid-19 positive or negative.

Keywords Covid 19, 2019-nCoV, SARS-CoV-2, X-Ray, Computer Vision, Machine Learning, Deep Learning

1. INTRODUCTION

In this epidemic of COVID-19, people will continue to suffer until people receive the vaccine. A lot of scientific research is being done continuously. So, until people receive vaccines they should be tested at a correct time so that they can be cured and prevent the spread of coronavirus from that person. Test analysis is often performed in automated, high-throughput, medical laboratories by medical laboratory scientists. Test samples can be obtained by various methods, including a nasopharyngeal swab, sputum (coughed up material), throat swabs, deep airway material collected via suction catheter or saliva.

Reverse transcription polymerase chain reaction (RT-PCR) first uses reverse transcription to obtain DNA, followed by PCR to amplify that DNA, creating enough to be analyzed. RT-PCR can thereby detect SARS-CoV-2, which contains only RNA. The RT-PCR process generally requires a few hours.

This complete process from collection, testing and making of reports takes about a day. The situation is even worse at places that are not equipped with testing laboratories and the biggest problem is contamination of the equipment with which samples are taken.

After going through many articles the world demands a fast, reliable and secure way of testing. Here comes the role of Computer Vision, Machine Learning and especially Deep Learning as it is described as the state-of-the-art for all analysis of medical imaging and plays an important role. Recent studies and radiologists specify that the physical examination of the body shows the chest radiographs were found abnormal as it infects the respiratory system mainly. Studies also state that chest X-Rays are insensitive in the early stages of the disease. Further if quarantined the patient's X-Rays often reveals changes in the lungs. So, the above findings could be a green signal to make advancement in the field of computer vision, machine learning and deep learning as X-Ray images could help to detect the presence of Coronavirus.

Recent advancement in the field of machine learning and especially deep learning helps to identify and classify patterns in medical images. Similarly X-Rays were used to detect COVID-19 but, the

models are struggling to cope up with the accuracy, more false positive rates and mandatory characteristics.

So, we will be introducing a new model with better accuracy and which will try to fulfill all the flaws and the model will finally be merged with flask api for making it available for users so that they can upload their chest X-Ray and automatically find whether he/she is covid positive or negative. The scalability doesn't end here; our application can be integrated with the systems available in the laboratory. This complete process is not costly as all the laboratories are equipped with the mobile x-ray machines which can produce x-ray instantly and our application will classify the image into positive or negative COVID. The presence of patchy and/or confluent, band-like ground glass opacity or consolidation in a peripheral and mid-to-lower lung zone distribution on a chest radiograph. Studies of chest also shows that lung shadowing goes to 69%. Our model will be built keeping all the facts above.

2. LITERATURE SURVEY

Title: Deep Learning in Medical Image Analysis

Author: Dinggang Shen,Guorong Wu,Heung-Il Suk

Identification and formulation of the problem

The computer based analysis for better interpreting images have been in the medical imaging field. In the view of the image interpretation, recent advancement in the field of machine learning and especially deep learning has a support hand to identify and classify patterns in medical images. The hierarchical feature representations from the data, instead of handcrafted features mostly designed based on domain-specific knowledge, lies at the core of the advances.

Deep Learning has proved to be the state-of-the-art in the field of image analysis in the terms of advancement of medical advancement. The decade has witnessed the importance of medical imaging e.g. computed tomography (CT), magnetic resonance (MR), positron emission tomography (PET), mammography, ultrasound, X-ray, and so on, for the early detection, diagnosis, and treatment of diseases. In real life the analysis of the medical images are done by the experts specially radiologists and physicians. This paper has given overview of various deep learning techniques by giving explanation of DEEP MODELS like:

1. Feed-forward neural networks, Deep Models.
2. Unsupervised feature representation learning-Stacked Auto-Encoder, Deep Belief Network, Deep Boltzmann Machine.
3. Fine-tuning deep models for target tasks.
4. Convolutional neural networks.
5. Reducing overfitting

The explanation gives a great overview how deep learning has advantage. It attracts researchers to work on this field of improving medical imaging to investigate CT, MRI, PET, and X-Ray, etc. The introduction about how deep learning can help in medical imaging for localization, cell structures detection, tissue segmentation, computer aided detection and diagnosis/prognosis.

Critical Analysis:

1. Completely explains the impact that computational modeling has on clinical applications and scientific research.
2. After explaining the deep learning techniques to work on gives a great idea behind the state-of-the-art in the field of image analysis.
3. It does not explain the working of all the techniques or models to interpret the model intuitively.

Title: Finding COVID-19 from Chest X-rays using Deep Learning on a Small Dataset

Author: Lawrence O. Hall, Rahul Paul, Dmitry B. Goldgof, and Gregory M. Goldg

Identification and formulation of the problem

This paper describes the current testing technique by explaining that the tests require a significant amount of time to produce results with a 30% of false positive rates. COVID-19 has been an issue for everyone and affected each and every sector. The biggest problem is that testing demands testing tools and kits which are unable to match with the demand. X-Ray machines are widely available and provide images for diagnosis quickly. X-Ray tests can be performed without increased risk, unlike laboratory tests that involve probing the patient's respiratory system. This paper explains the usefulness of X-Ray images for the diagnosis.

Details of the dataset used:-

1. 135 chest X-Ray of COVID-19.
2. 320 chest X-Ray of viral and bacterial pneumonia.

A pre-trained deep convolutional neural network, Resnet50 was trained on 102 COVID-19 and 102 pneumonia samples in 10-fold cross validation. The model has an overall accuracy of 89.2% with a COVID-19 true positive rate of .8039 and an AUC of 0.95.

An ensemble of the three types of CNN classifiers(Resnet50, VGG and other CNN models) was applied to a test set of 33 unseen COVID-19 and 218 pneumonia cases. The overall accuracy was 91.24% with the true positive rate for COVID-19 of 0.7879 with 6.88% false positives for a true negative rate of 0.9312 and AUC of 0.94. In this model the last layer has been removed and replaced by a trainable part which consists of global average pooling followed by a fully connected layer of 64 units with dropout and finally a classification layer with sigmoid function.

Critical Analysis:

1. This paper provides the information of the models used and other hybrid models.
2. It also has a comparative study about the CT scan and X-Ray images findings.
3. Proper explanation of how the false positive rate can be decreased is also mentioned.
4. 6% of false positive rate which is not feasible to make the model for real time use.
5. Dataset size is small which is the biggest disadvantage the model faced while training.

Title: Convolutional neural networks for multi-class brain disease detection using MRI images

Author: Muhammed Talo, Ozal Yildirima,Ulas Baran Baloglub, Galip Aydinc, U Rajendra Acharya

Identification and formulation of the problem

This paper is based on the classification of brain diseases using MRI images. It is difficult for the manual diagnosis of the brain abnormalities as it is difficult to observe the minute changes in the MRI images in the early stages. The challenging task is to select the features and classifiers to obtain the high performance. Hence, deep learning models have been widely used for medical image analysis over the past few years.

The work proposed is related to employing many pre-trained models like AlexNet, Vgg-16, ResNet-18, ResNet-34 and ResNet-50 to classify MRI images into normal, cerebrovascular, neoplastic, degenerative, and inflammatory diseases classes.

Here again the state-of-the-art is described as deep learning transfer learning models. Among all the above five models ResNet50 wins with the accuracy of 95.23% ± 0.6. They confirm that their model is ready to be tested with real time MRI images to detect abnormalities.

The main problem has been highlighted here about the availability of the labelled data. Previous studies in the literature had to deal with feature extraction, and this arises performance and accuracy drawback for the developed hybrid solutions. Both the above problems can be solved by using pre-trained models as they already know how to classify the data fed.

Their contribution is that being the first study which involves five brain classes: degenerative disease, inflammatory disease, cerebrovascular disease, neoplastic disease, and normal class and they almost doubled the number of images used(1074 images).

They used 2 major steps to train the model with MRI images:

1. They have only trained the attached few layers of the models for 15 epochs and set the learning rate hyper-parameter to the value of 1e-3.They fine-tune both convolutional base and fully connected layers by unfreezing all layers.
2. Fine-tuning term is used to unfreeze all the layers of pre-trained models. In other words, initially, only the attached layers of pre-trained models are trained for 15 epochs, then the whole network is unfreezed to re-train all layers.

Critical Analysis:

1. The model presented in the paper has an accuracy of 95.23% ± 0.6 with MRI images.
2. The model is classifying into normal, cerebrovascular, neoplastic, degenerative, and inflammatory diseases classes with such great accuracy.
3. The main problem is the lack of availability of labelled data.

Title: COVID-19 detection from chest X-Ray images using Deep Learning and Convolutional Neural Networks

Author: Antonios Makris**,** Ioannis Kontopoulos, Konstantinos Tserpes

Identification and formulation of the problem

This paper tells about the state-of-the-art that pre-trained convolutional neural networks were evaluated as of their ability to detect infected patients from chest X-Ray images. Due to the small number of samples, they used transfer learning, which transfers knowledge extracted by pre-trained models to the models to the model to be trained. A dataset consisting of 336 X-Ray images was created by mixing available X-ray images from patients with confirmed COVID-19 disease, common bacterial pneumonia and healthy

individuals. The experimental results demonstrate that the classification performance can reach an accuracy of 95% for the best two models.

The proposed model in this paper incorporates a large number of CNN architectures in an attempt to not only distinguish X-Rays between COVID-19 patients and people without the disease, but also find the pneumonia patients. The model is completely a classifier for respiratory diseases.

A brief description about Deep learning approaches for COVID-19 detection based on image classification is introduced. The proposed CNN model is based on pre-trained transfer models (ResNet50, InceptionV3 and Inception-ResNetV2). In terms of getting high accuracy from the small dataset sample of X-ray images a transfer learning technique is applied by employing the ImageNet dataset. The result after training and testing was that ResNet50 was found to be superior.

The ResNet18 pre-trained ImageNet network is used and the results showed an accuracy of 95.12% on CXR images. A deep convolutional neural network called COVID-Net showed a high sensitivity (87.1%) and a precision of 96.4% for COVID-19 cases.

The results demonstrated a strong correlation between estimated uncertainty in prediction and classification accuracy, thus enabling false predictions identification. Finally, after the evaluation of the performance of five pre-trained CNN networks regarding the detection of COVID-19 from CXR. The results showed that VGG19 and MobileNetv2 achieved the higher accuracy, 93.48% and 92.85% respectively.

Critical Analysis:

1. The experimental results demonstrate that the classification performance can reach an accuracy of 95% for the best two models.
2. The results showed that VGG19 and MobileNetv2 achieved the higher accuracy, 93.48% and 92.85% respectively.

Title: Detection of coronavirus Disease (COVID-19) based on Deep Features

Author: Prabira Kumar Sethy, Santi Kumari Behera

Identification and formulation of the problem

This research paper states the implementation of SVM classifier. The suggested classification model, i.e. resnet50 plus SVM achieved accuracy, FPR, F1 score, MCC and Kappa are 95.38%,95.52%, 91.41% and 90.76% respectively for detecting COVID-19 (ignoring SARS, MERS and ARDS). It also states that the model is superior compared to other classification models. The dataset is collected from various resources like Github, Kaggle and Open-i in the form of X-Ray images. The model is based on deep CNNs for the identification of COVID-19 as a classification task.

They prepared two dataset first 25 X-Ray COVID-19 images from Github and Kaggle and the second contains 133 X-Ray images from Open-i. These two dataset are examined separately and the features were extracted based on deep learning architectures such as AlexNet, VGG16, VGG19, GoogleNet, ResNet18, ResNet50, ResNet101, InceptionV3, InceptionResNetV2, DenseNet201 and XceptionNet. The deep features obtained are classified by SVM.

The deep features are extracted from fully connected layers and fed to the classifier for training purposes. The deep features obtained from each CNN network are used by SVM classifier.

Discussing the results ResNet50 with SVM gives the highest accuracy of 95.38% and in terms of F1 Score, MCC and Kappa, again stands apart from others. Hence, resnet50 and SVM result in better classification for detection of COVID-19 with accuracy, FPR, F1 score, MCC and Kappa are 95.38%,95.52%, 91.41% and 90.76% respectively.

Critical Analysis:

1. ResNet50 with SVM gives the highest accuracy of 95.38%.
2. Other characteristics that show great results such as FPR, F1 score, MCC and Kappa are 95.38%,95.52%, 91.41% and 90.76% respectively.
3. The models are suffering from a small size of dataset.

Title: CovidAID: COVID-19 Detection Using Chest X-Ray

Author: Krithika Rangarajan, Vinay P. Namboodiri, Chetan Arora

Identification and formulation of the problem

As the number of cases is rapidly increasing day by day and with the limited testing kit for diagnosis, it is impossible for every patient with respiratory illness to be tested using conventional techniques, as conventional techniques take more time for diagnosis it is difficult to give faster results. In this work, we proposed the use of chest X-Ray to detect COVID-19 infection as this will help quarantine high-risk patients which have COVID-19 infection detected in their chest X-Ray as X-Ray machines are easily accessible in many hospitals. We can prioritize the selection of patients by the use of chest X-Ray to decide whether to keep the patient in the ward along with other patients or isolate them in COVID-19 areas.CheXNet is a 121-layer DenseNetbased model trained on the ChestX-ray14 dataset comprising of 112,120 frontal-view chest X-Ray images which can classify into the following classes: Normal, Bacterial Pneumonia, Viral Pneumonia and COVID-19. Our model is trained in two division, the one which classifes into the above four classes, and the other conguration with three classes (clubbing viral and bacterial pneumonia into one).Our model gives 90.5% accuracy with covid-chestxray-dataset.

Critical Analysis:

1. X-ray imaging is much more widespread and cost effective than conventional diagnostic tests.

Title: Classification of COVID-19 in chest X-ray images using DeTraC deep convolutional neural network

Author: Asmaa Abbas, Mohammed M. Abdelsamea, MohamedMedhat Gaber

Identification and formulation of the problem

Chest X-ray is the first imaging technique that plays an important role in the diagnosis of COVID-19 disease. CNN architecture is one of the best deep learning approaches as its ability to learn features automatically from domain-specific images. To train CNN architecture the popular strategy is transfer learned knowledge from a pre-trained network

Three major scenarios to accomplished Transfer learning

1. shallow tuning
2. deep tuning
3. fine-tuning

In this paper we have used Decompose, Transfer, and Compose (DeTraC), for the classification of COVID-19 chest X-ray images. The DeTraC model consists of three phases.

1. To extract deep local features from each image we train the pre-trained CNN model of DeTraC.
2. For simplification of local structure we apply the class-decomposition layer of DeTraC.
3. We use a class composition layer to refine the final classification of the images.

Details of the dataset used:

- 80 samples of normal CXR images.
- CXR images which contain 105 and 11 samples of COVID-19 and SARS.

High accuracy of 93.1% (with a sensitivity of 100%) was achieved by DeTraC in the detection of COVID-19 X-ray images

Critical Analysis:

1. DeTraC can deal with any irregularities in the image dataset by investigating its class boundaries using a class decomposition mechanism.
2. Validating the method with larger datasets is not possible.

Title: Unveiling COVID-19 from Chest X-ray with deep learning: a hurdles race with small data

Author: Enzo Tartaglione, Carlo Alberto Barbano, Claudio Berzovini, Marco Calandri, and Marco Grangetto.

Identification and formulation of the problem

In this work, possible obstacles have been highlighted in successfully training a deep model, ranging from the proper choice of the architecture to-be-trained to handling removable biases in medical datasets. The model consists of certain phases. First pre-processing of chest images and lung segmentation will help in removing any bias present in the data. Deep model will be Pre-trained on the feature extractor.

Extensive experiments show that extracting a “COVID” feature from CXR isn't a simple task. Such a problem should be addressed very carefully: it's very easy to misinterpret excellent results on test-data, still showing poor generalization on new data within the same domain. Such a test can be performed thanks to the possibility of using CORDA, a larger dataset comprising COVID cases. Of course, the quantity of available data is still limited but allowed us to find some promising seminal classification results. The ongoing collection and sharing of an outsized amount of CXR data is the only way to further investigate if promising CNN results can aid within the fight to COVID pandemic.

Critical Analysis:

1. The only way introduced in the paper is through CXR with CNN.

Title: A Critic Evaluation of Methods for COVID-19 Automatic Detection from X-Ray Images

Author: Gianluca Maguolo , Loris Nanni

Identification and formulation of the problem

In this research paper two experiments were conducted in both cases our training and test sets consist in combinations of the four datasets - NIH dataset, CHE dataset, KAG dataset, COV dataset.In this paper,different testing protocols used for automatic COVID-19 diagnosis is compared and evaluated from X-Ray images in the recent literature. Which shows that similar results can be obtained using X-Ray images that do not contain most of the lungs. The lungs are removed from the pictures by turning to black the middle of the X-Ray scan and training our classifiers only on the outer part of the pictures.

Dataset used:

1. NIH dataset
2. CHE dataset
3. COV dataset

Hence, it is deduced that several testing protocols for the recognition are not fair and that the neural networks are learning patterns in the dataset that are not correlated to the presence of COVID-19.The validity of the usual testing protocols is discussed in this paper as most papers dealing with the automatic diagnosis of COVID-19. This paper showed that these protocols might be biased and learn to predict features that depend more on the source dataset than they do on the relevant medical information.

Critical Analysis:

1. Shows bias results as prediction is mainly based on a dataset rather than on medical information.

Title: COVID-19 detection from chest X-ray images using CNNs models: Further evidence from Deep Transfer Learning

Author: Mohamed Samir Boudrioua

Identification and formulation of the problem

For reducing COVID-19 spread around the world early dignosis of the novel coronavirus can be really helpful with the help of detection of COVID-19 infection from chest X-ray images using Deep Learning.

Details of the dataset used:

Split	COVID-19	Healthy	Pneumonia
Training set	247	799	1598
Testing set	62	201	402

Due to lack of dataset it is difficult to train CNN model from scratch, so we used deep transfer method in this study as it can extract features learned on one problem and can use them on a new. We pre-trained deep CNNs models on the train dataset.To make the model ideal for feature extraction, we don't include the classification layers at the top and create new classifier and add it at top of the model.At last before training we freeze the convolutional base.

Critical Analysis:

1. Difficult to evaluate performance of the model as the whole dataset is imbalanced

Title: Comparative study on the clinical features of the coronavirus 2019 pneumonia with other pneumonia

Author: Dahai Zhao, Feifei Yao, Lijie Wang, Ling Zheng, Yongjun Gao, Jun Ye, Feng Guo, Hui Zhao, Rongbao Gao

Identification and formulation of the problem

This paper provided a study between covid-19 pneumonia and non covid-19 pneumonia patients,All patients had a history of exposure to COVID-19 patients or travelled back from Hubei before their illness. Similar symptoms were presented by both groups of patients including fever and cough, these symptoms are also common in other acute respiratory infections, such as influenza, respiratory syncytial virus, and other respiratory viruses as well.

Most COVID-19 patients but non-COVID-19 patients had bilateral pneumonia with the feature of multiple mottling and ground-glass opacity on CT images. This result suggests that COVID-19 infection has similar features with many other respiratory virus infections, triggered a strong innate inflammatory immune response, and caused depletion of lymphocytes after infection.The ratio of mean of neutrophils was more in COVID-19 than in non-COVID-19 patients, although there was no statistical difference between them. Previous studies show that high neutrophils contribute to acute lung damage, and are associated with severe disease in patients with influenza infection.

Previous reports showed that a proportion of COVID-19 patients had differing degrees of liver function abnormality. The results suggested that patients with COVID-19 may have multiple tissue or organ damage besides liver injury.

Critical Analysis:

1. Patients with Covid-19 patients showed similar abnormalities in other acute respiratory infections.
2. Although they slighter higher neutrophils which contributed to other severe diseases in patients with other influenza diseases.
3. The limitations of this research was lack of data.
4. Some laboratory tests were not conducted in some patients because the COVID-19 patients were from 2 hospitals.
5. There was a lack of severe infection to compare findings with severe infection with mild infection
6. There was a lack of a pediatric population.

Title: Efficient Pneumonia Detection in Chest X Ray Images Using Deep Transfer Learning

Author: Mohammad Farukh Hashm, Satyarth Katiyar ,Avinash G Keskar 3 ,Neeraj Dhanraj BokdeandZong Woo Geem

Identification and formulation of the problem

This paper described how CT scans can be utilised to diagnose Covid-19 in early stages, the paper also describes best comparative study between multiple implementations. As the dataset was very less so using data augmentation techniques, a larger dataset was created. The chest x-ray images were passed through the process of scan line optimization such that it eliminates all the other body parts.

Multiple existing models are taken into consideration including Dense CNN, GoogleNet121, ResNet etc.

Following architecture was discussed:

- **Transfer learning:** In transfer learning, a model that is trained for a particular task is employed as the starting point for solving another problem.

- **Data Augmentation:** Duplicating dataset to make sure the model doesn't overfit.

- **Fine tuning the architecture:** SGD(Stochastic Gradient Optimizer) was used to provide better generalisation and models were trained for 25 epochs.

Critical analysis:

1. On multiple implementations, it was turned that all models had 99% or more accuracy and 0.03% except the Xception model.
2. DenseNet121 turned out to be best among, but using a single model wasn't able to solve the problem completely.
3. A weighted matrix was used with multiple models, resulting in each model contributing to 97% accuracy with 0.087% loss.
4. Weighted matrix results outweighed others in confusion matrix.
5. Following analysis shows that using a deep learning model can provide faster diagnosis.

Title: A Deep Learning System to Screen Novel Coronavirus Disease 2019 Pneumonia

Author: Xiaowei, XiangaoJiang, ChunlianMa,PengDu, XukunLi, ShuangzhiLv, LiangYuaQinNi, YanfeiChen, JunweiSu, GuanjingLang, YongtaoLi, HongZhao, JunLiu, KaijinXu, LingxiangRuan, JifangSheng, YunqingQiu, LanjuanLi

Identification and formulation of the problem

This paper described about Covid-19 detection from pneumonia using CT scans.
CT examination is routinely performed on every patient with fever and respiratory symptoms in the early stage, and is repeated for dynamic observation, since it is cheap and easy to operate. Using CT images to screen patients can improve the early detection of COVID-19, and ease the pressure on laboratory nucleic acid testing.

The CT imaging of COVID-19 presents several distinct features, according to past studies. These features include focal ground-glass shadows mainly distributed along the pleura, multiple consolidation shadows accompanied by the "halo sign" of the surrounding ground-glass shadow, multiple consolidations of different sizes, and grid-shaped high-density shadows.In this study, deep learning technology was used to design a classification network for distinguishing COVID-19 from

IAVP. In terms of the network structure, the classical ResNet was used for feature extraction. A comparison was made between models with and without an added location-attention mechanism. The experiment showed that the aforementioned mechanism could better distinguish COVID-19 cases from others. Furthermore, multiple enhancement methods were involved in our study, such as image patch vote and Noisy-OR Bayesian function, in order to determine the dominating infection types. Models with a location-attention mechanism can classify COVID-19, IAVP, and healthy cases with an overall accuracy rate of 86.7%, and would be a promising supplementary diagnostic method for frontline clinical doctors.

Critical Analysis:

1. Covid-19 infected patients showed various abnormalities in lungs including ground glass opacities or mixed ground glass opacities.
2. ResNet120 + SVM showed better accuracy than other models.
3. The following implementations had some weakness, which includes that it doesn't work properly in blurry images or images where patients had other infectious diseases as well.
4. The overall accuracy turned out to be 86.7% for CT scans.

Title: COVIDX-Net: A Framework of Deep Learning Classifiers to Diagnose COVID-19 in X-Ray Images

Author: Ezz El-Din Hemdan1 , Marwa A. Shouman1 , and Mohamed Esmail Karar 2,3 , IEEE, Member

Identification and formulation of the problem

This paper discusses the disadvantages of using CT scans to detect Covid-19 in patients and how X-ray images can be utilised to detect Covid-19 in real time.

The main disadvantage of using CT imaging is the high patient dose and costs scan. Nevertheless, X-ray images cannot easily distinguish soft tissue with a poor contrast to limit the exposure dose to the patients. To overcome these limitations, Computer-Aided Diagnosis (CAD) systems have been developed to assist physicians to automatically detect and quantify suspected diseases of vital organs in X-ray images and in recent years AI and machine learning techniques integrated with it to provide better results.

The aim was to develop a new framework COVIDX-Net which utilises multiple existing implementations to provide a generalised solution for detecting Covid-19.
The COVIDX-Net framework includes three main steps to accomplish the diagnostic procedure of novel Coronavirus, as follows:

- **Preprocessing** : All X-ray images have been collected in one dataset and loaded for scaling at a fixed size of 224 X 224 pixels to be suitable for further processing within the deep learning pipeline.
- **Training model and validation** : In order to start the training phase of selected and/or tuned one of seven deep learning models, the preprocessed dataset is 80-20 split according to the Pareto principle.
- **Classification** : In the final step of the proposed framework, the testing data is fed to the tuned deep learning classifier to categorize all the image patches into one of two cases: confirmed positive COVID-19 or normal case (negative COVID-19),

Critical Analysis:

1. Using X-ray images is more feasible than CT scans.
2. Most existing models fail when it comes to detecting normal cases properly.
3. The highest precision of deep learning classifier to detect only positive COVID-19 was achieved by ResNetV2, InceptionResNetV2, Xception, and MobileNetV2, but their corresponding performances were worst to classify the normal cases correctly.
4. VGG19 and DenseNet201 models to be applied for in the CAD systems to identify the health status of patients against the COVID-19 in X-ray images.

Title: Imaging Profile of the COVID-19 Infection: Radiologic Findings and Literature Review
Authors: Ming-Yen Ng, Elaine YP Lee, Jin Yang, Fangfang Yang, Xia Li, Hongxia Wang, Macy Mei-sze Lui, Christine Shing-Yen Lo, Barry Leung, Pek-Lan Khong, Christopher Kim-Ming Hui, Kwok-yung Yuen, Michael David Kuo

Identification and formulation of the problem
This paper describes various findings in Covid-19 patients from Shenzhen and Hong Kong.

All patients had at least one chest CT performed, while four patients also had follow-up CT. Five patients had chest radiographs (CXR), three of which had follow-up CXR on a daily basis. Two patients had six follow-up CXR and one patient had ten follow-up CXR.

These tests had limitations, as the number of patients were very less and analysing was time taking.

All tests were taken into consideration and following results were analysed:

- They found out that the most common findings on chest CT were bilateral ground-glass opacities with or without consolidation in the lung periphery.
- Pleural effusions and lymphadenopathy were absent in all patients.
- They found out many similarities with SARS, Both pathogens demonstrate predominantly ground-glass opacities.

In Chest Radiograph scans, they found out out of Five patients had CXR along with CT thorax examinations that:

- Two patients showed normal CXR findings, despite also having CT examinations performed on the same day showing ground glass opacities.
- The other three CXR examinations showed consolidation.
- One CXR showed lower zone predominance, whilst the other two CXR examinations did not show any zonal predominance.

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