**COVID-19 RECOGNITION FROM CHEST X-RAY IMAGES USING DEEP LEARNING**

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***Abstract***— ***Coronavirus disease (COVID-19) is a pandemic virus that has caused thousands of deaths and infected millions of people worldwide. Effective screening of infected patients is a key step in the fight against COVID-19 . Due to the increase in cases of COVID-19, test kits available in the hospital is minimal. In order to prevent the spread of the disease, an automated detection system is needed . To prevent the further spread of this disease, it is necessary to detect positive cases as early as possible. The use of convolutional neural networks (CNN) in conjunction with medical imaging can be helpful in accurate detecting this disease. Current methods of diagnosis for COVID-19 use RT-PCR, which is a less-sensitive and expensive diagnostic test that requires highly trained medical personnel. The use of X-rays in COVID-19 diagnostics is a quick, accessible, and reliable alternative. Using pre-trained deep-learning algorithms and maximizing the detection accuracy, we propose a robust approach for the automatic detection of COVID-19 from digital chest X-ray images. Networks were trained to classify two different schemes: covid and non-covid. The proposed model has achieved an accuracy level of 97.19%, 95.42%, 96.23% and 93.87% based on Xception, VGG16, Resnet and Inception. COVID-19 diagnosis can be significantly accelerated and more accurate with this computer-aided diagnostic tool due to the high accuracy of this tool.***

**Keywords**—***covid 19,chest x-ray image,CNN,model training, deep learning***

Introduction

A reverse transcription-polymerase chain reaction (RT-PCR) is the standard method for detecting the presence of SARS-CoV-2 in respiratory secretions or nasopharynx samples. Although RT-PCR is said to be highly specific, its sensitivity can range from 60 to 70%. Therefore false negatives are a serious concern especially in the beginning of the disease process. Diagnostic imaging tests have been critical in detecting and treating these patients and have been used to diagnose, determine the severity, guide treatment, and determine whether the treatments are working. According to most scientific and radiological associations, imaging tests should not be used for screening. Convolutional Neural Networks (CNNs) can be very useful for image classification on large datasets. COVID-19 classification and detection have been extensively explored using CNN , reaching a far better level of accuracy than previous methods. The CNN report shows that healthcare professionals can pinpoint patients at higher risk of disease development with remarkable accuracy. It can be used for binary classification to multi-class classification . CNNs have already demonstrated promising results in detecting intricate structures in high-dimensional datasets using multi-layer function representations. Because of its usefulness, availability, and low cost, chest Xray is generally the first-line imaging test in patients with suspected or confirmed COVID-19, though it is less sensitive than computed tomography (CT).

# Literature survey

## S.V.Kogilavani , J. Prabhu, R. Sandhiya, M. Sandeep Kumar, UmaShankar Subramaniam, Alagar Karthick ,M. Muhibbullah and Sharmila Banu Sheik Imam,"COVID-19 Detection Based on Lung Ct Scan Using Deep Learning Techniques",Hindawi, 2022.[19]

CNN is a deep learning method that takes an input image and assigns weight to different objects in the image, allowing it to distinguish between them. To classify the data, deep learning architectures such as VGG16, DenseNet, MobileNet, Xception, Efficient Net, and NASNet are used. Each model has been trained over 50 epochs. The input is CT scan images from a chest tomography. To filter the size of all input samples, the image filtering preprocessing technique is used. There are several methods for assessing the performance of a model. The measures used to estimate chest CT scan images are accuracy, precision, recall, and F-score.

## Amir Rehman, Muhammad Azhar Iqbal, Huanlai Xing and Irfan Ahmed, ” COVID-19 Detection Empowered with Machine Learning and Deep Learning Techniques: A Systematic Review”, applied sciences, 2021.[4]

CT images has been proposed as an essential substitute tool for COVID-19 detection. Here the CT images of patients are collected from China National Center for Bioinformation (CNCB) and COVIDNet-CT repository from github. They used transfer learning method to improve the performance of CNN on covid 19 testing using CT images. The Grad-Cam visualization techniques is established to explore and understand the covid affected area in the CT image. To address the issue, researchers must develop appropriate ML/DL techniques capable of producing better results with small datasets.

## Wentao Zhao , Wei Jiang1 & Xinguo Qiu ,"Deep learning for COVID‑19 detection based on CT images", scientific reports,2021.[24]

CT images have been proposed as an important alternative tool for COVID-19 detection. The CT images of patients are obtained from the China National Center for Bioinformation (CNCB) and the COVIDNet-CT github repository. They used the transfer learning method to improve CNN's performance on covid 19 testing using CT images. Grad-Cam visualization techniques are used to explore and comprehend the covid affected area in a CT image.

## Joy Iong-Zong Chen, "Design of Accurate Classification of COVID-19 Disease in X-Ray Images Using Deep Learning Approach", Journal of ISMAC,2021. [9]Author : Pillalamarry Mahesh, Yakkala Gnana Prathyusha, Botlagunta Sahithi, S Nagendram

Using x-ray and the Histogram-Oriented Gradients (HOG) methodology, this study developed an accurate classification method for performing a reliable detection of COVID-19 viral patterns. In this study, 10 fold cross-validation with confusion metrics can be used to detect various diseases caused by lung infection, such as Pneumonia corona virus positivity or negativity. CNN is a deep learning algorithm that can be used in the processing of medical images to support accurate and timely decision-making. CNN training is then used to interpret new medicinal images using pattern recognition. The proposed CNN method achieves high detection accuracy in a quick and efficient manner. The study also used limited datasets from various sources to analyse system robustness by responding to real-world scenarios.

## Boran Sekeroglu and Ilker Ozsahin,"Detection of COVID-19 from Chest X-Ray Images Using Convolutional Neural Networks", Original research,2020.[6]

Cohen provided a total of 225 COVID-19 chest x-ray images. It also included 131 male patients and 64 female patients. Because this is the first publicly available COVID-19 x-ray image collection, and it was created in a short period of time, the dataset used in this study does not have complete metadata. Several categorized experiments were carried out to evaluate the convnet's efficiency on the considered image. Convnet experiments, statistical measurement experiments, and transfer learning experiments were the three types of experiments

## Mohammad Rahimzadeh , Abolfazl Attar,"A modified deep convolutional neural network for detecting COVID-19 and pneumonia from chest X-ray images based on the concatenation of Xception and ResNet50V2 ", Informatics in medicine ,2020. [11]Author:Moutaz Alazab, Albara Awajan, Abdelwadood Mesleh, Ajith Abraham, Vansh Jatana, Salah Alhyari

In this paper, they used introduced training techniques to train several deep convolutional networks for classifying x-ray images into three classes: normal, pneumonia, and covid-19. This paper makes use of two open source datasets: kaggle (14,8633 images) and github (222 images). They proposed a neural network that is a hybrid of the Xception and Resnet networks. By combining multiple features extracted by two robust networks, this network achieved the highest accuracy. The network is trained in 8 stages in a row.

## Moutaz Alazab, Albara Awajan , Abdelwadood Mesleh, Ajith Abraham, Vansh Jatana, Salah Alhyari, "COVID-19 Prediction and Detection Using Deep Learning", ijcisim, 2020. [12]

To forecast the number of COVID-19 confirmations, three forecasting methods were used: the prophet algorithm (PA), the autoregressive integrated moving average (ARIMA) model, and the long short-term memory neural network (LSTM). The COVID-19 detector, which is based on CNN, outperformed in terms of precision, recall, and F-measure. When using augmentation, the COVID-19 detector produced better results. As the time between training and validation became shorter, the training process improved.

## Parag Chatterjee Mainak Biswas, and Arnab Kumar Das, "Specialized covid-19 detection techniques with machine learning", Journal of Physics: Conference Series,2021. [13]

VGG19, MobileNet, Inception, Xception, and Inception ResNet were the convolutional neural network architectures used in this study. Following several experiments, a parameter known as layer cut-off was defined as the number of un-trainable layers beginning at the bottom of CNN. It employs the transfer learning technique to detect the COVID-19 disease automatically. The benefits of transfer learning include improved results for detecting abnormalities in medical image datasets.

## Pillalamarry Mahesh, Yakkala Gnana Prathyusha, Botlagunta Sahithi, S Nagendram,"Covid-19 Detection from Chest X-Ray using Convolution Neural Networks", ICMAICT, 2020. [15]Author : Joy Iong-Zong Chen

There are several methods for diagnosing COVID-19, but they are both expensive and time-consuming. By using a chest x-ray, we can save money and time. However, expert radiotherapists are required to diagnose x-rays. As a result, we created a model that can detect COVID and non-COVID X-rays automatically. Deep Learning algorithms are currently producing the best results in disease classification. Furthermore, features learned by pre-trained Convolution Neural Network (CNN) models on large-scale datasets are extremely useful in image classification tasks. We train and test our model to determine whether the images are COVID or normal. We use analysis to determine the best CNN model for the job. The accuracy metrics are used to validate the model's classification.

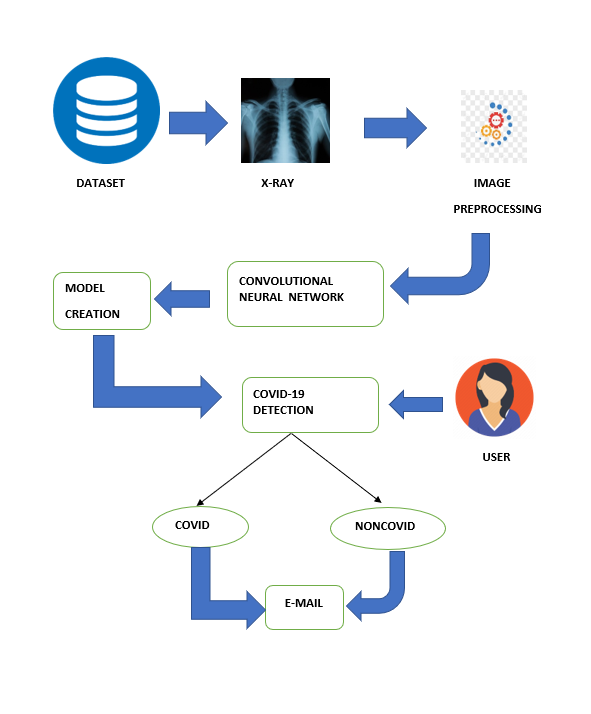
## **proposed methodology**

There are 192 countries that are affected in the covid-19 pandemic and 150 million cases reported worldwide. A deep learning system will increase both speed and accuracy in order to overcome the fallbacks in the current system. Based on chest x-ray images and convolutional neural networks, we developed an automated prediction of covid-19. Covid-19 can be detected most effectively by chest x-ray.

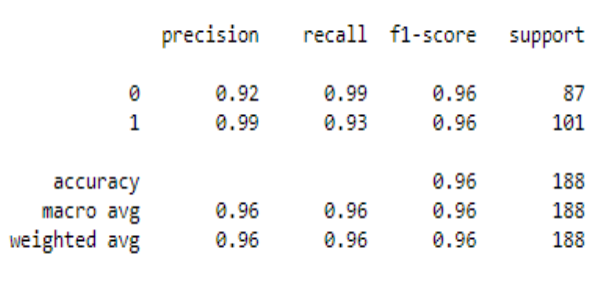
## Advantages:

* An X-ray Image is a much more accessible and cost effective test than the others.
* The portable x-ray machines also allow for testing inside isolation wards, reducing the need for additional Protective Equipment(PPE).

# I . system architecture



# Results and discussions

The COVID-19 is highly contagious, so controlling its transmission path effectively is crucial. The proposed work uses different deep learning algorithms (Xception, Inception, VGG, Resnet) to identify covid 19 from x-ray images. The training and testing phases are preceded by a preprocessing phase that includes data augmentation. In order to make an accurate prediction, evaluation metrics such as Precision, Recall,F1-score are used. Research findings indicated that Convolutional Neural Networks have the latent to detect respiratory diseases with the best accuracy, although a large amount images are needed, achieves an accuracy of 95% train accuracy and 98% of validation accuracy. By improving the networks, we can achieve 100% accuracy. The Accuracy metrics of Convolutional Neural Networks (CNNs) are shown below. 

# conclusion

COVID-19 is a disease caused by the SARS-CoV-2 virus, which was found in Wuhan, China, in December 2019. It is very contagious and has spread rapidly over the world. COVID-19 is most commonly associated with respiratory symptoms that resemble a cold, flu, or pneumonia. Despite the fact that vaccines were launched at the beginning of 2021, there is a pressing need for quick and precise instruments to increase the healthcare system's efficiency. Our method successfully separated photos into two categories: COVID-19 positive and COVID-19 negative. Early detection of the novel coronavirus is critical to preventing the virus from spreading to others. We develop a deep transfer learning system that analyses chest X-ray pictures from patients with COVID-19 and patients without COVID-19 to detect the condition automatically. Doctors have limited time due to the enormous number of patients treated outside or in emergencies, and computer-aided analysis could save lives through early screening and proper therapy. This is especially useful in a pandemic, when existing health resources do not meet the severity of the disease or the necessity for preventive measures. The next step for this approach is to create a web page or a mobile app that the general public may utilise. We can also use GradCam tools to see the COVID-infected areas visually for improved outcomes. This model demonstrates that Convolutional Neural Networks can work wonders in the medical field as well.

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