Original Article

Automatic Detection of COVID-19 in the Lungs X-ray Images using Pre-trained Deep Learning Model CNN

Rajni Prajapati[1], Vimal kumar[2]
[1,2]Meerut Institute of Engineering and Technology, Meerut, India,
Gmail: 9214rajniworld@gmail.com
DOI: 10.47750/pnr.2022.13.S01.08

Abstract

COVID-19 is a highly contagious epidemic, and detection in the incipient phase is essential to curb the expansion of the disease. Chest X-rays are used in detecting COVID-19 infection. Lung's images and CT -Scan photos are available for coronavirus analysis. This paper is composed of deep learning techniques and methods used to detect COVID-19 contamination in the lung images. The methods employed and collected datasets used for testing metrics are summed up. The Analytical metrics utilized by the methods which are completely comparable. Through this work, we have taken a perspective on COVID-19 affected chest x-ray scanners and healthy patients. After sorting and pre-processing the images and implementing the data addition, we applied deep-learning-based CNN models to compare their performance with other models. The aim is to provide a helping hand to the most distressed medical professionals who are analyzing images with two eyes, detect COVID-19 . According to this analysis we provide a proposed methodology that uses deep learning , dropout technique with python language on Google Colab platform for reduces over-fitting by this deep learning technology. During the testing phase, I got 98.1% accuracy by increasing convolution layer and dropout layer. Our proposed methodology gives better accuracy than other compared models. The primary goal of this paper is to present research on medical image processing and define and implement the proposed CNN model.

Keywords: X-rays, Learning Model CNN, COVID-19.

1. INTRODUCTION

COVID-19 is a new world health menace found at the end of 2019. The international organization, World Health Organization (WHO), first revealed the spread of the COVID-19 infection in March 2020, which is called the COVID-19 pandemic. Coronavirus has many symptoms of respiratory infection, including pneumonia, cold, sneezing and cough. A person who has contracted corona disease shows many symptoms like fever, sore throat, breathlessness, cough and fatigue. The COVID-19 was detected in Wuhan in China as a series of pneumonia cases [1]. The WHO has reported the timing of the introduction of the Corona virus between 2 to 10 days. However, some sources suggested that the breeding period can last more than two weeks and that the longest fecundation period may show double exposure [3]. Tracking Corona virus disease and diagnosis is essential to understanding the COVID-19 epidemic[33-35], informing case management and pressing transfers. The patients suspected of having an infection, the following diagnostic methods are used: real-time reverse transcription-polymerase chain reaction (RT-PCR) to detect SARS-CoV-2 by sputum, throat swab and extracellular samples. In addition to this paper-based COVID-19 tests are also performed where a fibre-containing paper-binding compound is required [4]. The Coronavirus infection is revealed as lung infected part, and CT scan and chest X-ray images are mainly used in recognition of lung infected part. So, we have used deep learning in this paper to classify and find out Covid19 [7,8].

2. Deep Learning in Medical Area

Deep learning (DL) is a branch of machine learning (ML), and machine learning is a branch of Artificial Intelligence (AL). A deep learning study finds complexity in big data sets utilizing the background streaming algorithm to show how a machine should manipulate its internal parameters absorbed to calculate representation in each layer from the portrayal in the previous one. Machine learning systems are used to realize objects in images, decipher text, posts or products of interest to users, and pick up important search results [9]. Artificial Intelligence (AI) models, medical experience, and image research may have the energy to produce a beneficial, lasting effect on people's lives in a relatively small-time span. The analysis by computer and

medical image analysis includes image recovery, image processing, image study, and image-based envision [10]. The medical-image analysis has heightened to incorporate computer vision, pattern-identification, image-separation, and machine learning (ML) in many dimensions [12].

In-deep learning is one of the most widely used methods to provide accurate state art. This opened the door to new medical image analysis [13]. In-deep learning programs in the medical care field address a wide batch of issues, from infection diagnosis to cancer diagnosis to personalized medical counseling [14, 15]. We are all in a state of flux, turning all this knowledge into useful information, positron-emission-tomography (PET), X-ray, Computed Tomography (CT) Scan, Functional Magnetic Resonance Imaging (FMRI) measures the brain activity, diffusion tensor imaging (DTI) and Magnetic Resonance Imaging (MRI) are common methods utilized in medical-image centers [17]. Among these medical imaging technologies, CT has a very high density of very dense tissue but depends on the skill of the doctor, and there is a chance of losing scans. X-Ray is a simple and modest, best fit for initial medical screening, but like CT and X-Ray harm the human body, so patients cannot keep it frequently [18]. Unlike CT-scan and X-rays, Magnetic Resonance Imaging don't have ionizing radiation and can observe clearly in the soft tissue, but MRI usually takes longer in some patients who may not be suffering, especially those who have implanted metal implants such as a cardiac pacemaker [19]. Compared with the great need for medical imaging analysis, the population of specialist doctors is significantly less in underdeveloped or developing countries around the world. Second, a person's eyesight may deteriorate, and the doctor's condition may be impaired. Thus, misdiagnosis often happens & it takes towards the misdiagnosis and protracted illness. Due to these problems of manual medical image analysis, researchers were learning how to transform people with computer-based technology to develop the accuracy and productivity of medical image analysis [20].

3. Organization of the Paper

The main purpose of the paper is COVID-19 detection through radiography by analysing pre-existing research papers using pre-existing models. In this paper, we are giving a comparison of the pre-existing scheme by analysing many papers . This work compares different models of deep learning for detection, classifying the corona viruses from the images. Section 1 defines COVID-19 introductory part. Section 2 describes deep learning. Rest paper defines as the following manners: section 3 will describe related work comparison between accuracy, precision, sensitivity, specificity and F1score. Section 4 will define the proposed methodology by using pre-existing CNN model, section 5 introduces the result, and section 6 concludes this research work.

4. Related Works

Bukhari et al.2020 [2] also utilized ResNet50 convolutional neural network formulation in 278 chest X-Ray pictures, divided into three groups as standard, pneumonia and COVID-19. This technique has yielded encouraging results and demonstrated significant lung changes caused by COVID-19 in some forms of pneumonia. CXR pictures are a vital diagnostic test for the effects of COVID-19 on lungs. Approximate 278 CXR pictures were evaluated using ResNet50 CNN architecture in the current study. The digital photographs were obtained from libraries availed by the Montreal University and the National Health Institute. The CXR digital pictures are categorized into 3 classes tagged as generic, -Pneumonia-and-COVID19. The third group contained digital X-ray images of patients who were identified with the COVID19 virus, and the 2nd class had pictures of the lungs and pneumonia originated from other viruses. The data-set of the radioscopy consisted of 90 pictures of lungs infected with COVID19, 93 pictures of lungs without any radioscopy disturbances and 96 pictures of a sufferer with pneumonia developed by other viruses. In this set of data collection, 80% of pictures were monitored for education, and 20% were used for examination. Advanced training structures were utilized to identify COVID19 diseases in CXR pictures of the lungs. Data analysis revealed that a computer-driven system acquired diagnostic precision of 89.18%, and an F-1 score of 89S.19.

Narayan et al.2021[6] constructed COVID-Net, a comprehensive study-based model, to find out COVID19 cases. COVID-Net gained a victory rate of 92.4% accuracy and sensitivity. It is also using 13975 radiographic images received from various open access data. Design of a deep CNN designed to find out COVID cases in the X-ray pictures that are open-source network and accessible to the common people. Very good writers' information, COVID-Net is open-source network project for the acquisition of COVID 19 CXR pictures during the first exposure. We even established COVIDx, an open access standard. The database we produced includes 13,970 chest X-ray images in all 13,875 sufferer cases, with the maximum number of publicly available cases consisting of COVID-19 for the outstanding author's information. In addition, we are investigating how COVID_Net forms forecasts using interpretation way in an effort not only to gain a deeper understanding of the important issues combined with corona cases, which can assist physicians in advanced testing, but also to evaluate COVID-Net in an accountable manner in a clear way to ensure that it makes resolutions based on important details from the chest X-ray pictures.

Yang et al.2016 [11] distinct types of attributes were drawn and educated utilizing different machine learning techniques to improve the precision of predicting all-inclusive survival of patients with glioma on MRI. The highest characterization precision was achieved by trained linear discriminant analysis utilizing intense attribute derivation based on pre-trained AlexNet. The functionality of texture is widely used in the characterization of different types of tumor types, but its precision didn't surpass 46%. The Histogram features gained 68.5% precision in two types of classifications. This low precision may be due to sound. The sound prototype in MRI pictures was founded on the imaging system's coils number.

Suganyadevi et al.2020 [12] explain legitimate neural networks, especially artificial neural networks, is a subset of deep learning technique motivated by the natural direction operations of living organisms. Convolution neural networks are no different from multi-layer neural networks piled up on top of everyone. There are three broad layer types: group, convolutional, and fully connected. Firstst layer of the convolution model is the input layer, on that place height, width and depth dimensions of input images are mentioned as input-like parameters. The second layer is a convolutional layer which are explained with the layers number of filters, padding and activation, stride, and filter window size as parameters. Many research papers use transfer learning from pre-trained models on the Image-Net dataset. The input size of the image for the architecture is 224 x 224 or 229 x 229, but the set of data utilized to test and train the model consists of images of different sizes. The pre-processing step in the model to adjust the shape of the input images in the neural network. This section mentions the fine-tuning-based method and transfer learning.

Wang et al.2020 [13] first introduce the most important research question in the area of medical picture analysis and the previous information on transfer learning. Next, we duplicate the advancement of the fundamental concept and the convolutional neural network to transfer learning. Then select five common areas of medical imaging studies of the heart, breast, brain, lungs, and kidneys, list representative studies in detail, and summarize those methods. In the area of medical imaging research, it is imagined that self-monitoring learning and domain adaptation will moderately develop toward meta-learning in transfer learning accompanied by technologies such as data expansion. A combined transfer learning with augmentation learning and other models to evolve more functional and strong models is developing the presentation of extensive neural networks at the current level. However, this review paper will extend a normal and insightful idea for reviewing the growth and tendency of Transfer Learning in the field of medical imaging.

Lecun et al.1998 [14] Human sight is an active process of consecutively scanning an optical array in a brilliant user-defined manner using a tiny high-resolution in a large, low-resolution environment. Much of the future goal developments are anticipated to come from a system that associates RNNs and Convents that are constantly trained and determine where to look using Reinforcement Learning. The system that combines deep learning and enhanced learning is still in its initial phase, but has so far surpassed the Passive Vision System in the characterization of jobs and achieved magnificent outputs in learning a wide range of video games. Natural Language Understanding is one more field where deep learning will have a large effect in the future years. A system that uses RNNs to understand an entire sentence or document is expected to be much better as its strategies to selectively participate in one part at a time.

Khalid et al.2021 [15] This paper introduces comparisons of latest deep-convolution-neural-network architecture for the automatic division of pneumonia pictures founded on fine-tuned types of VGG-19, VGG-16, InceptionResNetV2, Resnet-50, Dense-Net201, InceptionV3, MobileNetV2 and Xception. The suggested activity was calculated using CXR images & CT scan data set, containing 6087 images. As an outcome, we can conclude that the well-designed type of Resnet50 depicts great satisfaction with the advancement rate of training and testing precision (over 96% precision). From the outcomes, it was noticed that the precision when using baseline CNN, Xception, VGG16 and VGG19 was lower than other data learning structures, as these final models helped to gain respectively 83.14%, 84.18%, 85.94% and 86.26 % precision. On opposite side, high accuracy is noticed by Inception-V3 (94.59%), DensNet201 (93.66%), InceptionResnet-V2 (96.09%), Resnet50 (96.61%) and MobileNet-V2 (96.27%). Additionally, MobileNet-V2 is demonstrated to get amazing outputs while ResNet50 offers a well association of the number of parameters and performance depicts fast training.

Apostolpoulos et al.2020 [16] In this study, an advanced convolution network of neural architectures was used to classify CXR pictures. The Transfer-Learning was imbibed to hold the unique attributes of the database. Two sets of data from different libraries were utilized to examine pictures of 3 classes: COVID19 bacteria, general condition and viral pneumonia. The paper setup the validity of a deep learning reading model with the assistant of precision, reactivity, and clear boundaries. In his study, using the latest convolution neural network architectures to split an assemblage of 1427 X-ray pictures, 224 COVID_19, 700 pneumonia and 504 standard radiological images was approved. Pass on Reading was accepted for handling unusual items available data. Secondly, a set of data consisting of 224 pictures with assured COVID-19 illness, 713 pictures with assured viral pneumonia and 504 pictures of simple conditions. The end result purpose is that a deep learning examination of X-ray imaging may produce important radiographic results related to corona illness, while the best precision, reactivity and clarity were gained by 96.78%, 98.66%, and 96.46%, respectively.

Minaee et al.2020 [17] describe learning transfer in a subset of 2000 radiograms utilized to teach four well-known convolution

neural networks, including ResNet50, Squeeze-Net, ResNet18 and DenseNet-121, to detect corona chest disease images of X-ray analyzes. We tested these models in 3000 other pictures, and many of these networks received 98% sensitivity (± 3%), while the specification rate was almost 90%. In addition to the sensitivity and clarity levels, we also introduce the active host feature (ROC) curve, accurate memory break, intermediate guesses, and matrix model for each confusion. CXR pictures from 2 databases form a corona X-ray 5000 database containing 2085 trainings and 3100 test pictures. We start at the top left corner of the picture, and every time we close a square circle of size N × N inside the picture, and make a postulation utilizing an educated model in a closed image. If closing that region causes the model to incorrectly characterize the COVID_19 picture as Non-COVID, that area will be considered contaminated with chest-X-ray pictures. On the other hand, if the circuit's closure does not affect the model's prediction, we conclude that the circuit does not. When we repeat this process in different N × N sliding windows, each time we move them in an S-line, we can get a remarkable map of the regions that may be infected with COVID-19.

Transfer learning, which has received growing attention, was used by Ioannis et al. 2020[16] for the same aim as COVID_Net. This research paper approved 220 COVID-19, 700 pneumonia, and 504 standard radiological images. They found 98.70% accuracy and 93.50% accuracy for the 3-class problem, sensitivity high, accuracy high, and specificity high. The purpose of the study is to calculate the operation of the latest CNN structures suggested in present days with a medical image separation. Especially, a process named Transfer Learning was embraced. Through transfer learning, the discovery of diversity unusual in the database of small medical images is a goal, often resulting in amazing outputs. Data sets were used in these two tests. First, a stock of 1420 X-ray pictures comprised 221 pictures with Covid19 certified illness, 712 photographs with assured bacterial pneumonia, and 500 photographs of common cases. Second, a set of data consisting of 220 pictures with Covid19 certified infections, 715 pictures with assured bacterial and viral pneumonia, and 503 photos of common situations. Dataset were stored on X-ray images available at public health care facilities. The results suggest that an In-depth study of X-ray imaging may produce important biomarkers that resemble to COVID-19 illness, while the best accuracy, sensitivity, and clarity were received by 96.78%, 89.66%, and 89.46%, respectively.

Shuai et al.2021 [18] studied Radiographic changes of COVID19 in CT-scan pictures, this study measured that AI techniques may be capable of excluding certain attributes of COVID_19 and furnish an early medical finding by pathogenic testing, thus conserving valuable time for illness control. To train the model of 325 images were acquired to attain the model. To examine the fragility of the model, 450 pictures were acquired for interior authentication from center-1 and 295 images were acquired from centers-2 and center-3 for exterior authentication. The internal authentication obtained a whole precision of 89.5% with a specificity of 0.88 and a sensitivity of 0.87.

Zhong et al.2020 [19], in this research, we present COVID-Net, a comprehensive CNN design architectured to find out the COVID incidents in open X-ray pictures that are open-source and provided to the general public. It introduces COVIDx, open access to a limited data set comprising 13,975 C-X-R images for all 13,870 patients, with the maximum number of cases in the public domain on COVID-19 according to the best authors information. An open access benchmark called COVIDx is also designed to assist COVID-Net training and testing. To get more COVID19 data as multilateral data is provided for data development. Specially, the COVIDx data-set consists of 358 CXR images in 266 cases of COVID_19. In chest X-ray pictures without nonCOVID19 pneumonia. There are many patient incidents and corresponding chest X-ray pictures. Specially, there are 8,066 cases of non-pneumonia cases and 5,538 cases of non-COVID-19 pneumonia. Documents that produce a data set to create a COVIDx data set are publicly available for open access. It may be noticed that COVIDNet gains good precision by approaching 93.3% test accuracy, thus focusing on the efficiency of human-machine use. It can be noticed that COVIDNet can attain 91.0% positive sensitivity to COVID-19 cases.

Razzak et al.2020 [21] describe that when image interpretation is done by medical professionals, it was constrained by image complexity and subjectivity. Medical professionals are overburdened with work, there is a fighting between professionals and fatigue. By seeing the success of deep learning, it is assumed as a promising and accurate solution for medical imaging and a chief technique for futuristic medical applications. The current chapter describes the latest deep learning architecture and its optimization when adopted for the classification and segmentation of medical images. This chapter ends with a discussion of the difficulties of deep learning methods in medical imaging and unanswered research questions.

Muhammad et al.2020 explained the motive of this research paper is to develop an advanced approach to automatically detect COVID-19 pneumonia in digital-X-ray imaging using advanced pre-educated reading algorithms while increasing the precision of detection. The website contains a blend of 1485 viral pneumonia, 423 COVID-19 and 1579 standard CXR images. The transfer learning method was utilized with the aid of picture enhancement to educate and authenticate many deep CNNs networks. Networks are trained to distinguish two distinct systems: i) COVID-19 and common pneumonia; ii) common, viral pneumonia and COVID19 with and without image improvement. Both tests have been evaluated using a five-point cross-sectional verification (CV) program with an average of 80% training and 20% with a separate (non-binding wrap) test. Horry et al. [22] utilized 4 well-known CNN models (VGG, Inception, Xception, and Resnet) previously trained. The models are 400

images used to analyze the effectiveness of the suggested method. The photos were divided into 3 categories, of which, 100-Photos with the Corona virus, 100 images - of pneumonia, and 200 photos - of healthy cases. The test results show that 80% precision is achieved in the above way. Punn et al. [23] This article introduces arbitrary samples and weigh how to work for the loss of a well-organized non-aligned classroom (transfer of learning) in deep-level advanced reading methods like baseline-ResNet, Inception-v3, Inception-ResNet-v2, DenseNet169, and NASNet-Large for binary making classification (such as conventional and COVID\19 cases) and classification (such as COVID_19, Pneumonia, and general case) for CXR background pictures. Accuracy, precision, recall, loss, and curve (AUC) are used to check the presentation of the models. Regarding the test results, the performance of each model is standard dependent Although; NAS-Net-Large has shown better points, unlike other properties. This set of data has been issued in two stages. In the first stage, 25,684 training pictures were considered for testing 1,000 pictures. Later in the second stage, 1000 testing specimens were incorporated into the training set to form the dataset of 26,684 training pictures. A new dataset of 3,000 radiographs was inaugurated for the test.

Li et al.2020 [24] present COVID-Mobile-Xpert: a simple Deep Neural Network based on mobile-app that can utilized CXR images to screen corona case and radiological path forecast. We manufacture and execute a new three-player knowledge transfer via distillation architecture consisting of a network of the pre-trained attending physician that draws chest X-ray image attributes from a large number of infected lungs X-ray, a well aligned Resident Fellow network that come to know about the important chest X-ray imaging attributes to distinguish b/w Pneumonia, COVID-19 and simple cases. We pre-educate the DenseNet121 based AP network utilizing the more resembled CXR8 data of 108,950 infected lung cases to draw out the chest X-ray imaging attributes of infected lungs instead of generic usual imaging features. The Chest X-ray picture dataset for COVID patient triage is consisted of 179 chest X-ray pictures from usual class, 179 from pneumonia class and 179 from COVID class consisting of posterior anterior and AP anterior posterior situations and we break it into training/validation/testing data-sets in each class.

Hemdan et al.2020 [25] proposed COVID Net to identify COVID19 in CXR images. It received 90% accuracy, low precision and low score using 25 Coronavirus images and 25 standard pictures. This study aims to launch a new deep-learning structure, COVIDXNet to help radiologists naturally identify COVID19 in X-ray pictures. COVIDX-Net associates 7 distinct models of convolutional neural network models, like an altered VGG19 and the 2nd type of Google-Mobile-Net. The COVIDX-Net testing and evaluation was successful depend on 20-80% of Xray machine pictures of the training model & test stages, separately. The Visual Geometry Group Network and Dense Convolutional Network models demonstrated well and uniform automation of the COVID19 categories with F1- score of 0.89 and 0.91 standards & COVID 19. The bad category presentation is found in Inception-V3 model with F1 points of 0.67 in simple cases and 0.00 in COVID19 cases.

Prabira et al.2021 [26] SVM separate the affected corona X-ray images from others images. It consists 3 categories of X-ray pictures namely, pneumonia, COVID-19 and common. The model is beneficial for a physician who will distinguish between a pneumonia patient and a COVID-19 patient and fit people. The SVM-I is tested to find COVID-19 using the in-depth features of 13 distinct convolution neural network models. SVM data produce the excellent outcomes utilizing the in-depth ResNet50 feature. Partition model, namely ResNet50 and SVM gained precision, reactivity, FPR and F1score 95.33%, 95.33%, 2.33% and 95.34% respectively. Also, the very high precision obtained by SVM and ResNet50 at 98.66%. These matrixes depend on X-ray images found in the Kaggle treasury and GitHub. They combine a set of data 381 X-ray images, i.e., front view of CXR pictures of 126 pneumonia, 126-COVID19 & 126 fine people. The intense attributes of deep convolution neural network models are derived and used by SVM classifier for noticing of COVID-19. In some studies, Generative Adversarial Network (GAN) was utilized by Khalifa et al. [28] in pneumonia detection in CXR images. The author spoke about the crisis and demanded its resilience with the rise of GAN production images. Data, (5863 CXR data for two categories: conventional and pneumonia), were used with standard, in-depth study models like Alex-Net, Google-Net, Squeeze-net and Resnet-18 for Pneumonia. It (study) underlines that Resnet-18 performed very well among-other in-depth transmission models in with GAN. Additionally, the comparative performance of different CNNs of division into two categories and without additions is shown. Generative Adversarial Networks are a neural networks of unique types in which 2 networks are teached concurrently, one focusing on image processing and the second is focusing on discrimination. Generic adversarial Networks (GANs) provide a way to read in-depth presentations without detailed training data. The study concludes that Resnet18 is an in-depth transmission model that is most suitable for measurement accuracy and has achieved 99% use of GAN as image enhancement Vipul Narayan et al. [28].

Comparison of Existing Scheme

Table 1 is describes pre-existing models such that ResNet101, Squeeze-NET,VGG19,Inception,Resnet50,COVIDXNet,COVIDNeT,ResNet50,VGG19,MobileNetV2,RsNet50.These models are defined on the basis of their accuracy, precision, sensitivity, specificity and F1score [29].

Table 1: Comparison of the existing scheme

Model	Accuracy	Precision	Sensitivity	Specificity	F1score	Dataset	Researchers
ResNet101	96.1	84.2	78.3	98.2	81.2	1427	Tzani.et.al [16]
Squeeze-Net			98	92.9		5000	Minaee.et.al [17]
VGG19	90	83	100		91	50	Hemdan.et.al [25]
Inception	89.5	71	88	87	77	1065	Shuai.et.al [18]
Resnet50	96.61	94.92	98.43	98.49	96.67	6087	Khalid.et.al [15]
ResNet50	95.33		95.33		95.34	381	Prabira.et.al [26]
COVIDX-Net	90	83			91	50	Hemdan.et.al [25]
COVID-Net	93.3		91			1398	Wang.et.al [13]
ResNet-50	90.6		83.7			13975	Zhong.et.al [19]
VGG-19	83		58.7			13870	Alexander.et.al [10]
MobileNetV2	96.78		98.66	96.46		1428	Ioannis.et.al [16]
ResNet50	96.1	76.5		96.6	83.5	7065	A. Narin.et.al [27]
CheXNet	97.74	96.61	96.61	98.31	96.61	1485	Muhammad.et.al[21]

5. PROPOSED METHODOLOGY

We are making an effort to solve the COVID-19 test issue with the help of some in deep study CNN model. Deep learning method have been proven to be a marvelous practical skill method in the previous years, by this feature and ability to obtain complicated patterns of the input data, read relevant presentations of the basic information category in various field levels. These methods are increasingly being used in various related fields of computed tomography imaging, like as computer-assisted clinical programs and medical ultrasound photography, which assist in the field of clinical treatment, and various methods of early monitoring of diseases. Our proposed methodology helps us to differentiate well or unwell person by the help of lungs X-ray images.

COVID-19 Datasets Collection

Dataset refers to data collection or a combination of data. There are many archives used to find data sets for DL projects, including Google Database Search, Data.Gov, Earth Data, UCI Machine Learning Repository, Global Health Observatory Data Repository, Datahub.io., Kaggle etc. In Deep Learning, a set of data simplifies the collection of data taken by a computer as one part of prediction and analytical purpose. With this, the data collected must be made understandable and stable on the machine. In this work, 1036 chest X-ray images for training and 200 lungs X-ray images for testing, which have normal and pneumonia features, have been used, which detects COVID-19 Vipul Narayan et al. [30].

Image Pre-processing

Raw data may contain noisy data, missing data and inconsistent data. To clean raw data, pre-data processing is performed. In the first step, the data processing was to resize the X-Ray images as the image input of the model vary in dimensions. In deep learning, it uses some image processing method to maximize the model's accuracy through less training time.

First, we have to change our dataset images to 1000x1000x3 to reduce processing time and fit into CNN model. In the pre-image processing step, model need labeling of the dataset as the convolution neural network method equates to controlled reading in machine learning. Image preprocessing may contain different dimensions like “pixel brightness transformations”, “Brightness correctness”, “Geometric- transformation”, “image-filtering” and “segmentation”, and “Fourier transformation restoration”. Vipul Narayan et al. [31].

Augmentation of Images

CNN achiever better performance depends on the quality and quantity of dataset images. We apply data augmentation techniques to increase the insufficient data in training, and the techniques used to include “vertical flip”, “horizontal flip”, “noise”, “translation”, “blurring” and rotation of images by sixty-degree, ninety degree, one eighty degree, two seventy degree (60 °, 90 °, 180 °, 270 °). Image augmentation involves “scaling”, “cropping”, “flipping”, “padding,” “rotation”, “translation”, “Brightness”, “Contrast”, “saturation,” and “hue”.

Feature Extraction by CNN model

Now we are starting to build the CNN model as we have finished processing it before. Three layers of convolution with 2 x 2 metrics maximize-pooling should be used. Maximize-pooling is a way

to reduce image size by selecting a larger pixel value. It also helps to reduce external emissions and makes the model extra

standard. After that, we will design two layers that are fully connected. Some selected features create feature vectors as like entropy, mean, area, and variance.

Dropout

Regularization is a deep learning method for deduction over-fitting in the CNN network. Dropout is used to enhance the accuracy of the deep learning model with any dataset. In dropout technique many neurons are temporarily dropped for some time to increase model performance. If probability P=0.3 means 30% of neurons will escape during the model training phase, that means 70% neurons are active during model training phase, and 30 % neurons are not active in training time. Result is straight

CNN model uses a dropout layer to prevent over-fitting for the simpler neural network. In the regularization technique, some neurons are dropped during model training time.

Model training

Model training time is less after construction. We have been the ability to design artificial image, an artificial convolution neural networks. Division of the dataset into two fragments: training and testing. Finally, we will use the training dataset to construct and test the model. The model is built with the help of a training set, and a test set is used to validate the built model. In this study,

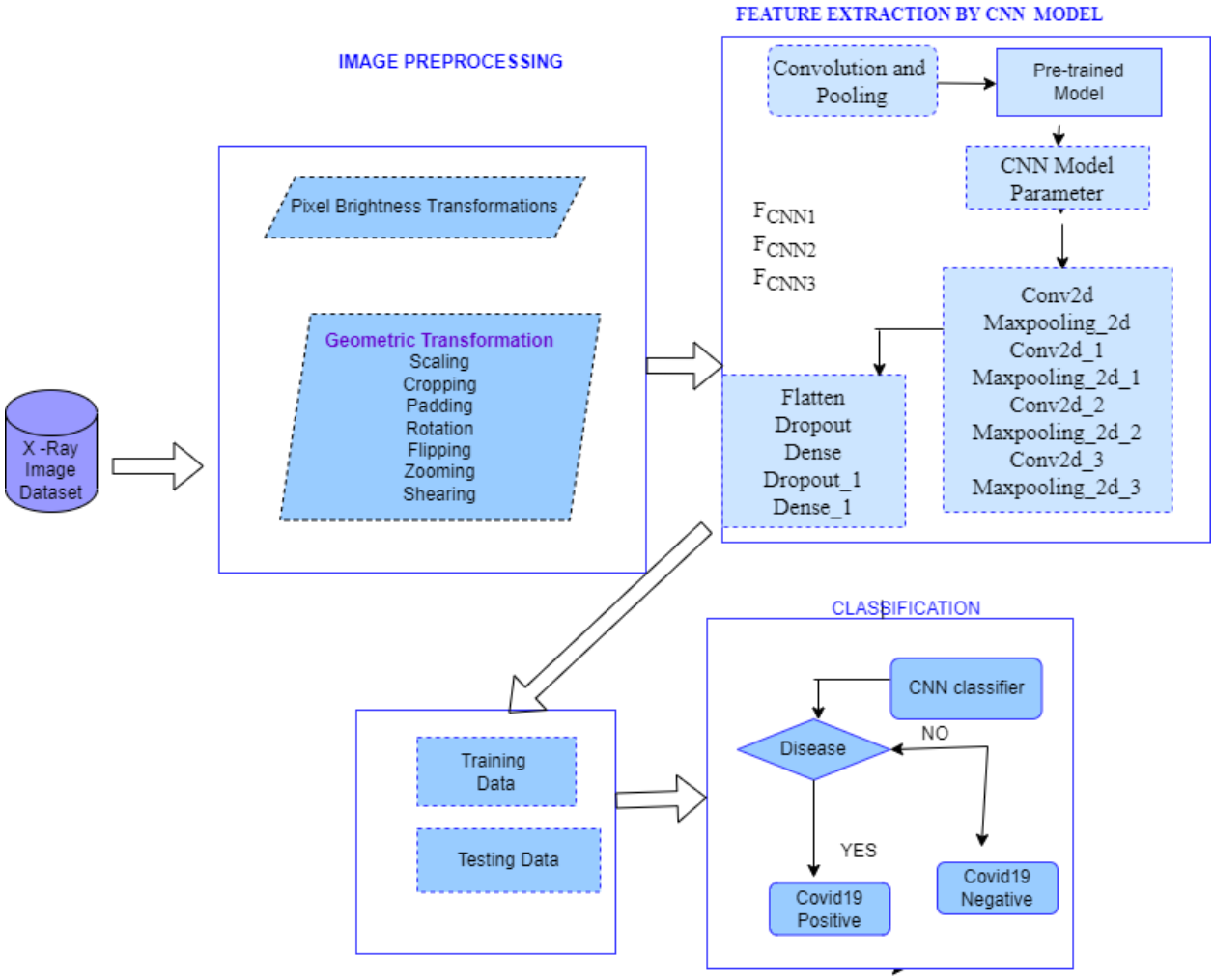

Fig 1: Proposed Framework

80% of data is considered as a training set, while 20% of data is considered as a test set. Database classification into a training and testing set is used to evaluate the performance of DL Models.

Model testing and evaluation

Firstly model has been trained after that, it is ready for testing and evaluation. . A tested dataset was achieved at this step.

The model accurateness has been confirmed in real. Lastly, the model that has been achieved might be utilized in the actual world. Model evaluation is the term of this step confirms model strengths and weaknesses. This implies that the model can be applied to another dataset Vipul Narayan et al. [32].

6. Result and Analysis

India has never seen COVID-19 as a like pandemic in the previous century. We have been collected dataset images from Kaggle in which many positive and negative COVID-19 images for the detection of COVID-19 infected persons are associated. CNN pre-trained model has been used for training. After training, we checked COVID-19 with the trained model during the testing phase and found out pneumonia virus and normal situation. We have compared our proposed methodology with other models, and it is found that my proposed methodology CNN gives the best performance of 98.1% accuracy, the precision of 96%, the sensitivity of 96 %, specificity of 97%, F1 score of 95.7% with other models. The proposed methodology can categorise Coronavirus images easily, as shown in the figure:

a. Normal image of lungs X-ray

b. Corona virus

Fig. 2: Normal image of the chest)

Fig. 3: COVID-19

Performance matrix evaluation finds accuracy, precision, sensitivity, specificity, F1score. In Fig.4 comparison of models and its accuracy in percentage is shown and results are as: ResNet101 have 96.1%, VGG19 have 90%, Inception have 89.5%, Resnet50 have 96.61%, ResNet50 have 95.33%, COVIDX-Net have 90%, COVID-Net have 93.3%, ResNet50 have 90.6%, VGG-19 have 83%, MobileNetV2 have 96.78%, ResNet50 have 96.1%, Proposed methodology-CNN have 98.1%. Our proposed methodology CNN gives better accuracy as compared to others.

In Fig.5 comparisons of models and its precision in percentage are ResNet101 have 84.2%, VGG19 have 83%, Inception has 71%, Resnet50 have 94.92%, COVIDX-Net has 83%, ResNet50 have 76.5%, and proposed methodology-CNN result is 96.5%. This proposed methodology gives better precision among all the above.

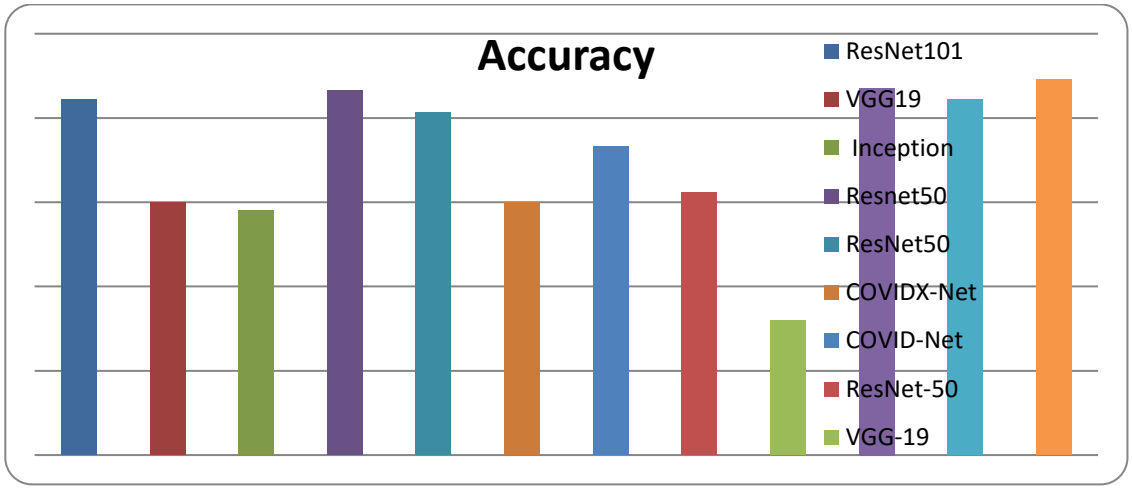

Fig 4: Comparison of accuracy

Fig. 6 gives better sensitivity as compared to other models. It is observed as follows: ResNet101 has 78.3, Inception has 88%, ResNet50 has 95.33%, COVID-Net have 91%, ResNet50 has 83.7%, VGG-19 have 58.7 and Proposed methodology-convolution neural network has 96% sensitivity. In this comparison, my proposed methodology of convolution neural network gives better sensitivity.

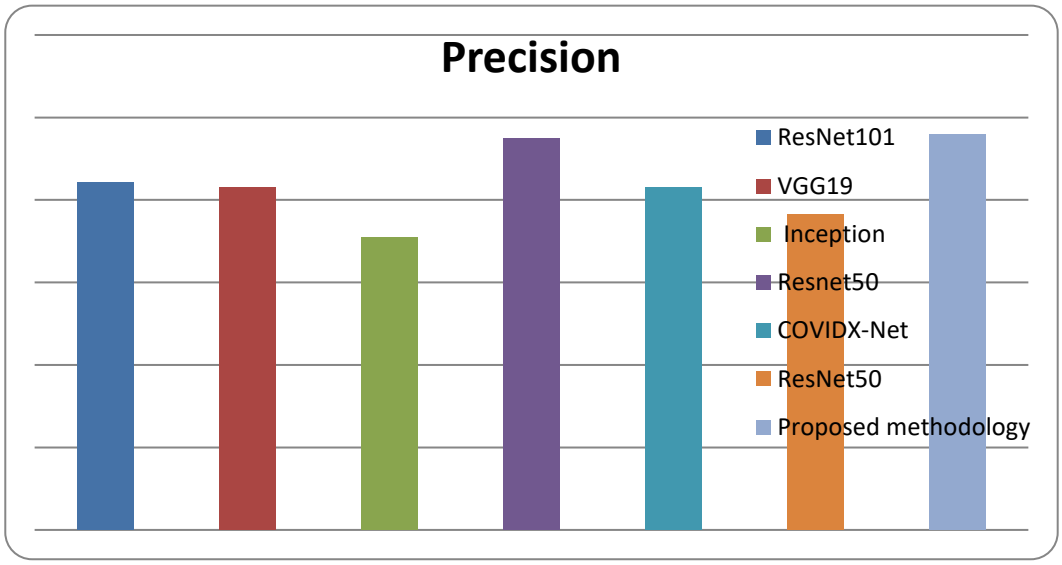

Fig 5: Comparison of precision

In this Fig. 7 depicts a model which gives specificity as follows: - Squeeze-Net has 92.9%, Inception has 87%, MobileNetV2-has 96.46%, Res-Net have 50-96.6% and the proposed methodology of convolution neural network has 97%. This proposed CNN model gives specificity better than other pre-existing schemes.

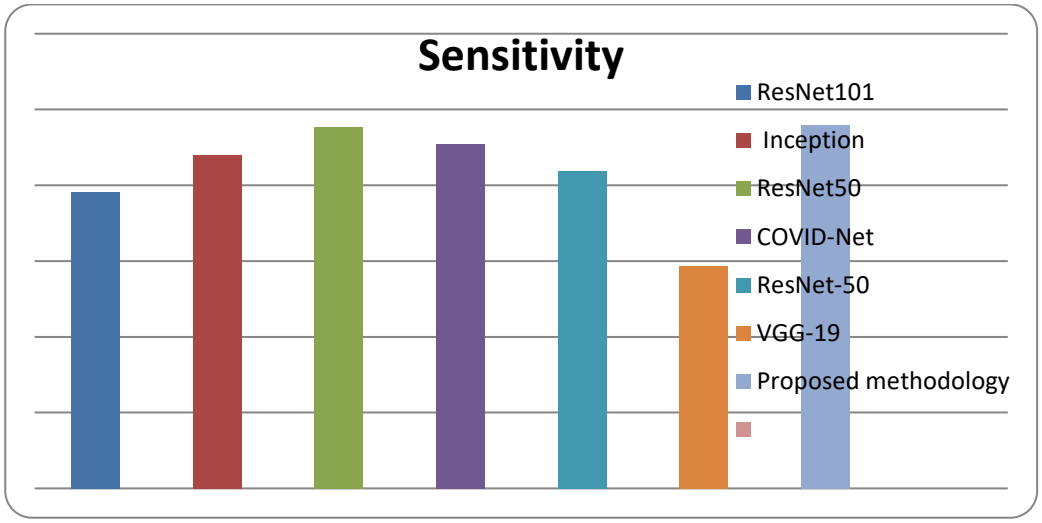

Fig 6: Comparison of sensitivity

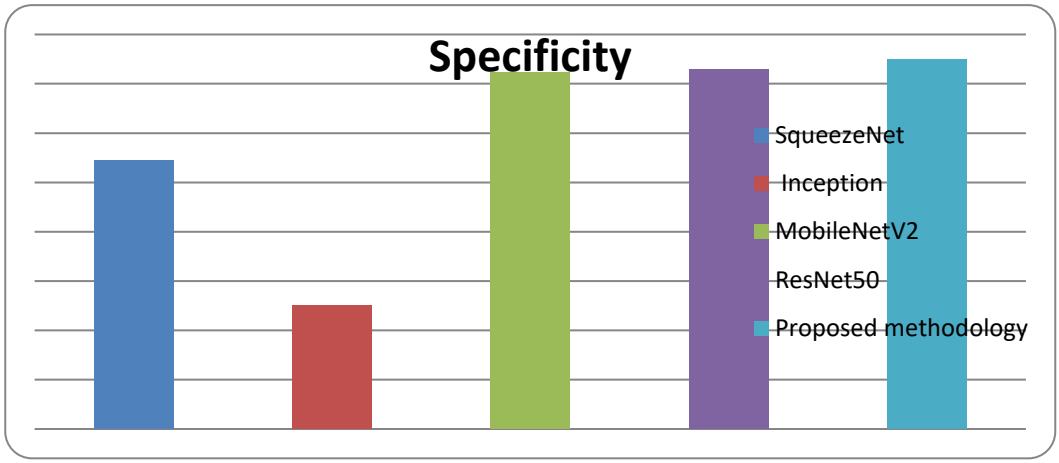

Fig 7: Comparison of Specificity

Fig 8 shows that better F1 score from other schemes. Comparison of models shown as following in percentage: ResNet101-81.2%, VGG19 -91%, Inception -77%, COVIDX-Net-91%,

ResNet50-83.5% and the proposed methodology CNN-95.7% . CNN model is better from other models in this comparison.

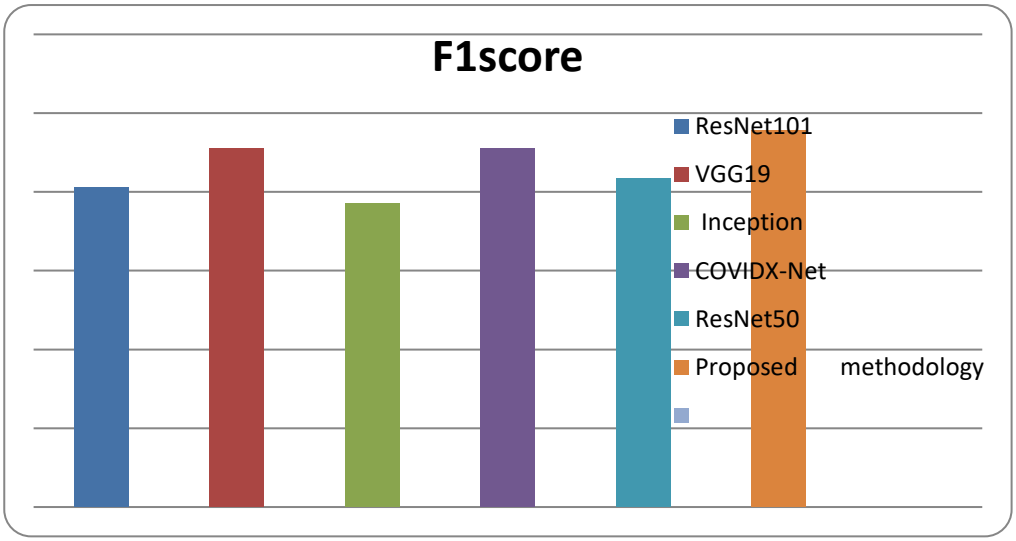

Fig 8: Comparison of F1score

7. Conclusion and Future work

This study explains that the diagnosis of COVID-19 using deep learning methods is very efficient, decisive, and flexible. In the future in hospitals, other repository available lung image datasets may be collected and preprocessed for future research work. Availability of data is qualitative, quantitative and preprocessed data, the performance matrix of deep learning model can be improved. Creating and annotating dataset are other research directions, and providing metadata information is another direction.

We have done the research and analyzed it by different research papers and datasets on deep learning technology. According to deep learning technology, the proposed methodology, which categorizes COVID-19 chest X-ray images into normal and infected. Our approach is designed into three hidden layers and dropout technique layers to prevent over-fitting. Dropout is used to design a simple neural network. Our proposed methodology is compared with different other models, which gives better performance than other pre-existing models. In the dataset, 1036 X-ray images for training and 200 images for test prediction have been used. This dataset have taken from Kaggle and Google Colab python platform used for execution proposed methodology. The proposed methodology gives better results with an accuracy value of 98.1%, precision has 96.5%, sensitivity has 96.7%,specificity have 97.2% and F1score have 97.4%. This model will help medical researchers, to produce better results and to take better decisions for doctors and other practitioners. In COVID-19, many patients have a respiration system failure, and many have different organ failures. In the duration of the pandemic, doctors were not easily available due to their busy schedule, and patients were dependent upon the machine aided treatments, in which deep learning have been used commonly. The proposed, designed model in this research will help for better treatment. We have full faith in our model to speed up and better treatment of COVID-19 patients. In this comparative analysis, CNN models give better confusion matrix than other models.

For future research, deep learning technology is an open field of research. Research on different types of datasets and different quantity of images should be included. This type of research will help doctors to reduce the burden and time of the treatment of patients. In the future, researchers will enhance the performance of the designed model by different aspects. Researchers can also analyze the solutions to problems and should develop multiple data sets for analysis.

Acknowledgement

This research is undergone by Meerut Institute of Engineering and Technology, Meerut, U.P. India.

REFERENCES

[1] Subramanian, Nandhini, Omar Elharrouss, Somaya Al-Maadeed, and Muhammed Chowdhury. "A review of deep learning-based detection methods for COVID-19." Computers in Biology and Medicine (2022): 105233.

[2]Bukhari, Syed Usama Khalid, Syed Safwan Khalid Bukhari, Asmara Syed, and Syed Sajid Hussain Shah. "The diagnostic evaluation of Convolutional Neural Network (CNN) for the assessment of chest X-ray of patients infected with COVID-19." MedRxiv (2020).

[3] Chato, Lina, and Shahram Latifi. "Machine learning and deep learning techniques to predict overall survival of brain tumor patients using MRI images." In 2017 IEEE 17th international conference on bioinformatics and bioengineering (BIBE), pp. 9-14. IEEE, 2017.

[4] Li, Xin, Chengyin Li, and Dongxiao Zhu. "Covid-mobilexpert: On-device COVID-19 screening using snapshots of chest x-ray." arXiv preprint arXiv:2004.03042 (2020).

[5] Li, Xin, Chengyin Li, and Dongxiao Zhu. "COVID-MobileXpert: On-device COVID-19 patient triage and follow-up using chest X-rays." In 2020 IEEE international conference on bioinformatics and biomedicine (BIBM), pp. 1063-1067. IEEE, 2020.

[6] Narayan, Vipul, and A. K. Daniel. "RBCHS: Region-based cluster head selection protocol in wireless sensor network." Proceedings of Integrated Intelligence Enable Networks and Computing. Springer, Singapore, 2021. 863-869.

[7] Han, Bowen. "Application of deep learning in medical imaging." In 2021 2nd International Conference on Computing and Data Science (CDS), pp. 49-56. IEEE, 2021.

[8] El Asnaoui, Khalid, Youness Chawki, and Ali Idri. "Automated methods for detection and classification pneumonia based on x-ray images using deep learning." In Artificial intelligence and blockchain for future cybersecurity applications, pp. 257-284. Springer, Cham, 2021.

[9]Vardasca, Ricardo, Lucia Vaz, and Joaquim Mendes. "Classification and decision making of medical infrared thermal images." In Classification in BioApps, pp. 79-104. Springer, Cham, 2018.

[10] Zhuang, Yan, Md Fashiar Rahman, Yuxin Wen, Michael Pokojovy, Peter McCaffrey, Alexander Vo, Eric Walser, Scott Moen, Honglun Xu, and Tzu-Liang Bill Tseng. "An interpretable multi-task system for clinically applicable COVID-19 diagnosis using CXR." Journal of X-Ray Science and Technology Preprint: 1-16.

[11] Pang S, Yang X (2016) Deep Convolutional Extreme learning Machine and its application in Handwritten Digit Classification.

[12] Narayan, Vipul, and A. K. Daniel. "Novel protocol for detection and optimization of overlapping coverage in wireless sensor networks." Int. J. Eng. Adv. Technol 8 (2019).

[13] Fu Y, Lei Y, Wang T, Curran WJ, Liu T, Yang X (2020) Deep learning in medical image registration: a review. Phys Med Biol65(20).

[14] Y. LeCun, L. Bottou, Y. Bengio, P. Haffner, Gradient-based learning applied to document recognition, Proc. IEEE 86 (11) (1998) 2278–2324.

[15] El Asnaoui, Khalid, Youness Chawki, and Ali Idri. "Automated methods for detection and classification pneumonia based on x-ray images using deep learning." In Artificial intelligence and blockchain for future cybersecurity applications, pp. 257-284. Springer, Cham, 2021.

[16].Apostolopoulos, Ioannis D., and Tzani A. Mpesiana. "COVID-19: automatic detection from x-ray images utilizing transfer learning with convolutional neural networks." Physical and engineeering sciences in medicine 43, no. 2 (2020): 635-640.

[17] Minaee, Shervin, Rahele Kafieh, Milan Sonka, Shakib Yazdani, and Ghazaleh Jamalipour Soufi. "Deep-COVID: Predicting COVID-19 from chest X-ray images using deep transfer learning." Medical image analysis 65 (2020): 101794.
[18]Wang, Shuai, Bo Kang, Jinlu Ma, Xianjun Zeng, Mingming Xiao, Jia Guo, Mengjiao Cai et al. "A deep learning algorithm using CT images to screen for Corona virus Disease (COVID-19)." European radiology 31, no. 8 (2021): 6096-6104.
[19] Wang, Linda, Zhong Qiu Lin, and Alexander Wong. "Covid-net: A tailored deep convolutional neural network design for detection of COVID-19 cases from chest x-ray images." Scientific Reports 10, no. 1 (2020): 1-12.
[20] Muhammad Imran Razzak, Saeeda Naz and Ahmad Zaib.et al. Deep Learning for Medical Image Processing: Overview, Challenges and Future.[J], Search, Computer Science: Computer Vision and Pattern Recognition. 2017.4
[21] Horry M.J, Chakraborty S, Paul M,Ulhaq A, Pradhan B, Saha M, Shukla N (2020) X-ray image based COVID-19 detection using pre-trained deep learning models.
[22] Punn, Narinder Singh, and Sonali Agarwal. "Automated diagnosis of COVID-19 with limited posteroanterior chest X-ray images using fine-tuned deep neural networks." Applied Intelligence 51, no. 5 (2021): 2689-2702.
[23] Li X, Zhu D (2020) Covid-xpert: An aipowered population screening of COVID-19 cases using chest radiography images.
[24] Hemdan, Ezz El-Din, Marwa A. Shouman, and Mohamed Esmail Karar. "Covidx-net: A framework of deep learning classifiers to diagnose COVID-19 in x-ray images." arXiv preprint arXiv:2003.11055 (2020).
[25] Sethy, Prabira Kumar, and Santi Kumari Behera. "Detection of Corona virus disease (COVID-19) based on deep features." (2020).
[26] Ali Narin, Ceren Kaya, and Ziynet Pamuk. "Automatic detection of Corona virus disease (COVID-19) using x-ray images and deep convolutional neural networks." Pattern Analysis and Applications 24, no. 3 (2021): 1207-1220.
[27]Khalifa, Nour Eldeen M., Mohamed Hamed N. Taha, Aboul Ella Hassanien, and Sally Elghamrawy. "Detection of Corona virus (COVID-19) associated pneumonia based on generative adversarial networks and a fine-tuned deep transfer learning model using chest X-ray dataset." arXiv preprint arXiv:2004.01184 (2020).
[28] Narayan, Vipul, and A. K. Daniel. "Multi-tier cluster based smart farming using wireless sensor network." 2020 5th International Conference on Computing, Communication and Security (ICCCS). IEEE, 2020.
[29] Choudhary, Shubham, et al. "Fuzzy Approach-Based Stable Energy-Efficient AODV Routing Protocol in Mobile Ad hoc Networks." Software Defined Networking for Ad Hoc Networks. Springer, Cham, 2022. 125-139.
[30] Narayan, Vipul, and A. K. Daniel. "CHHP: coverage optimization and hole healing protocol using sleep and wake-up concept for wireless sensor network." International Journal of System Assurance Engineering and Management 13.1 (2022): 546-556.
[31] Narayan, Vipul, and A. K. Daniel. "IOT based sensor monitoring system for smart complex and shopping malls." International Conference on Mobile Networks and Management. Springer, Cham, 2021.
[32] Narayan, Vipul, A. K. Daniel, and Ashok Kumar Rai. "Energy efficient two tier cluster based protocol for wireless sensor network." 2020 international conference on electrical and electronics engineering (ICE3). IEEE, 2020.
[33] Deshwal, Vaishali, and Vimal Kumar. "Study of Coronavirus Disease (COVID-19) Outbreak in India." The Open Nursing Journal 15, no. 1 (2021).
[34] Gupta, Mansi, and Vimal Kumar. "Revealing the demonstration of blockchain and implementing scope in covid-19 outbreak." EAI Endorsed Transactions on Scalable Information Systems 8, no. 29 (2021): e2.
[35] Gupta, Mansi, Vimal Kumar, Vikash Yadav, Rajesh Kumar Singh, and Mohd Sadim. "Proposed framework for dealing COVID-19 pandemic using blockchain technology." (2021).