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# Diagnosing Corona Virus Using Chest X-Ray Images

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**ABSTRACT-** Chest radiographs (X-rays) combined with Deep Convolutional Neural Network (CNN) methods have been demonstrated to detect and diagnose the onset of COVID-19, the disease caused by the Severe Acute Respiratory Syndrome Corona virus 2 (SARS- CoV-2). Toward automating the COVID-19 detection, application of deep learning-based chest radiograph classification (DL-CRC) framework is used to distinguish the COVID-19 cases with high accuracy from other abnormal and normal cases. The encouragingly high classification accuracy of our proposal implies that it can efficiently automate COVID-19 detection from radiograph images to provide a fast and reliable evidence of COVID-19 infection in the lung that can complement existing COVID-19 diagnostics modalities.

**Keywords** – CNN, deep learning, Covid-19, DL-CRC

## I. INTRODUCTION

COVID-19 is an infectious and fast spreading deadly virus and it was spreading all over the globe. The World Health Organization declared COVID-19 as a pandemic disease on March 11th 2020. An announcement of the pandemic also starts the panic of the increasing the spread of CORONA VIRUS. It is illustrated as a global safety emergency of its time and it has spread everywhere across all different countries. Government of varied nations are imposed different limitations and restrictions such as flight limitations, lockdown, social distancing and spreading awareness of the consciousness about cleanliness. But the Virus was spread at a high speed all over the world. For the infected people, the virus was directly attacked on the lungs. There are some assumptions that old or elder people with other diseases such as diabetes, Blood pressure etc., will be infected easily and it may affect their health deeply. In early stages, there is no correct and proper medical diagnosis for COVID- 19. About 78,115,053 positive cases are found across all countries in the world until 24th DEC 2020, where 1,717,640 deaths and 54,890,244 recovered cases were found.

In order to prevent this virus, the sick patient has to be screened with proper medical diagnosis. At early stages the detection was done by testing kits manually using a technique called Reverse Transcription Polymerase Chain Response (RT-PCR) test on respiratory tracts. The procedure which was used earlier was used to detect the disease. However, the testing method was manual, complicated, lack of equipment, and time-taking procedure with a normal positive success rate. The symptoms of the COVID-19 virus are having emphysema causing fever, whooping cough and breathing failure. Most of the CORONA VIRUS cases have identical similar spots on radiography chest X- ray photographs, those identical spots can be easily identified by comparing with other positive patient cases. Even though normal lungs X-ray images may serve early broadcast of infected cases, the X-rays of differing viral cases of pneumonia are comparably which may protrude with various other contagious and erythrogenic. Hence, it is hard for radiologist to identify corona virus from other different types of virus.

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Deep Learning

Deep learning is a subset of machine learning (all deep learning is machine learning, but not all machine learning is deep learning). Deep learning algorithms define an artificial neural network that is designed to learn the way the human brain learns. Deep learning models require large amounts of data that pass through multiple layers of calculations, applying weights and biases in each successive layer to continually adjust and improve the outcomes. Deep learning models are typically unsupervised or semi-supervised. Reinforcement learning models can also be deep learning models. Certain types of deep learning models—including convolutional neural networks (CNNs) and recurrent neural networks (RNNs)—are driving progress in areas such as computer vision, natural language processing (including speechrecognition), and self-driving cars.

Convolutional neural network (CNN)

A CNN is type of a DNN consists of multiple hidden layers such as convolutional layer, RELU layer, Pooling layer and fully connected a normalized layer. CNN shares weights in the convolutional layer reducing the memory footprint and increases the performance of the network. The important features of CNN lie with the 3D volumes of neurons, local connectivity and shared weights.

A feature map is produced by convolution layer through convolution of different sub regions of the input image with a learned kernel. Then, a nonlinear activation function is applied through ReLu layer to improve the convergence properties when the error is low. In pooling layer, a region of the image/feature map is chosen and the pixel with maximum value among them or average values is chosen as the representative pixel so that a 2x2 or 3x3 grid will be reduced to a single scalar value.

This results a large reduction in the sample size. Sometimes, traditional Fully-Connected (FC) layer will be used in conjunction with the convolutional layers towards the output stage. In CNN architecture, usually convolution layer and pool layer are used in some combination. The pooling layer usually carries out two types of operations viz. max pooling and means pooling. In mean pooling, the average neighborhood is calculated within the feature points and in max pooling it is calculated within a maximum of feature points. Mean pooling reduces the error caused by the neighborhood size limitation and retains background information. Max pooling reduces the convolution layer parameter estimated error caused by the mean deviation and hence retains more texture information.

## II. LITERATURE

Convolutional layer where images are translated into feature-map data by convolutional kernels or filters. In a 3D CNN, the kernels move through three dimensions of data (height, length, and depth) and produce 3D maps. Pooling layer, a filter moves across the convolutional output to take either the average or the weighted average or the maximum value. The goal of pooling layer is to progressively reduce the spatial size of the matrix to reduce the number of parameters and to control over fitting. Fully-connected layer, where a SoftMax function is used to get probabilities as it pushes the values between 0 and 1. Batch normalization is used to improve the training speed and to reduce over fitting. [1]

Data pre-processing and augmentation: All the data available on the internet have not been subject to the same preprocessing of the positive COVID-19 data the whole X-ray take up most of the screen,we find some blacks bar on the sides, so this become an issue. So, to solve this problem create a script that remove these black pixels from the samples from sides of the images. In this methodology the following steps are present: chest X-ray images preprocessing, data augmentation, transfer learning using DenseNet121, VGG16, MobileNet, InceptionV3, Xception, VGG19, and InceptionResNetV2 neural networks, feature extraction and ensemble classification. The model proposed is composed of two modes. A pre-trained start mode which transforms the input images into descriptor vectors. Another mode consists of several classifiers strongly connected together where each classifier will give its output its own prediction. [2]

Deep learning in smart health analytics is a prominent inter-disciplinary eld that merges computer science, biomedical engineering, health sciences, and bioinformatics. Various medical imaging devices have a dedicated image and signal analysis and processing module, on which deep learning-based models can be implemented to provide accurate, real-time inferences. The proposed DARI algorithm generates synthetic X-ray images by adaptively switching between a customized GAN architecture and generic data augmentation techniques such as zoom and rotation. The synthetic X-ray images are combined with the actual radiograph data to build a robust dataset for efficiently training the deep learning model. The second component of our DL-CRC

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framework. A custom CNN architecture is designed to construct the deep learning model to carry out automated feature extraction and classification of the radio-graph images. [3]

This step ensures that the pre-trained EfficientNet can extract and learn useful chest X ray features, and can generalize it well. Indeed, EfficientNets are an order of models that are obtained from a base model, i.e., EfficientNet-B0. In the proposed architecture, we demonstrated EfficientNet-B0, however, during the experimental evaluation, we considered other models. The output features from the pre-trained EfficientNet fed to our proposed custom top layers through two fully connected layers, which are respectively integrated with batch normalization, activation, and dropout. We generated several snapshots in a training session, and then combined their predictions with an ensemble prediction. At the same time, the visualization approach, which can qualitatively analyze the relationship between input examples and model predictions, was incorporated into the following part of the proposed model. EfficientNets are a series of models (namely EfficientNet-B0 to B7) that are derived from the baseline network (often called EfficientNet-B0) by scale it up width, depth, and resolution, EfficientNets have pulled attention due to its supremacy in prediction performance. [4]

Transfer Learning is an approach where information extracted by one domain transferred to another related domain. It is applied when the dataset is not sufficient to train the parameters of any network. In this part, four pre-trained CNNs are described to accomplish the proposed CNN-RNN architecture as follows: i) VGG19: VGG19 is a version of the visual geometry group network (VGG) based on deep network architecture. It has 19 layers in total including 16 convolutional layers with three fully-connected layers to perform on the ImageNet dataset. VGG19 used a 3 × 3 convolutional filter and a stride of 1 that was followed by multiple non-linear layers. Max-pooling is applied in VGG19 to reduce the volume size of the image and achieved high accuracy on image classification. ii) DenseNet121: Dense Convolutional Network (DenseNet) uses dense connections instead of direct connections among the hidden layers. In DenseNet architecture, each layer is connected to the next layer to transfer the information among the network. The feature maps are transmitted directly to all subsequent layers and use only a few parameters for training. The overfitting of a model is reduced by dense connections for small datasets. DenseNet121 has 121 layers, loaded with weights from the ImageNet dataset. iii) InceptionV3: InceptionV3 is used to improve computing resources by increasing the depth and width of the network. It has 48 layers with skipped connections to use a building block and trained on million images including 1000 categories. iv)Inception-ResNetV2: Inception-ResnetV2 network is a combination of inception structure with residual connections including 164 deep layers. It has multiple sized convolution filters trained on millions of images and avoids the degradation problem. [5]

In this paper[5], authors main contribution focused on screening COVID-19 in CXR images based on lung region as prior knowledge. Specifically, they firstly built MS-AdaNet, which utilizes multi-scale features in semantic prediction space to boost cross-domain lung segmentation task. They further investigated the differences in lung regions in different pneumonia including COVID-19. Then the multi-appearance CXR images were generated from MS-AdaNet for classification. MA-Net aggregated across the three appearances performed substantially better than any of the appearances on their own. In particular, they validated MS-AdaNet for CXR domain adaptation on three public challenging lung segmentation datasets and achieved satisfactory results in different combinations of source and target domains. [6] deep learning model based on CNN was designed and implemented to detect and classify the presence of COVID-19 in chest X-Rays and CT images. The study's main contribution involves applying selected image preprocessing techniques and the design of CNN architecture both encapsulated in a deep learning-based framework. The proposed framework pipelined the entire procedure in a manner to enhance the performance of the classification. Furthermore, we investigated the performance of the proposed model by juxtaposing the use of optimizer between the popular Adam and SGD. The result revealed that ourmodelachieved100%accuracyinclassifyingtheno velcoronavirus (COVID-19) using SGD. The outcome of this study showed that a CNN-based solution might be adopted in pre-screening suspected cases and confirmation of RT-PCRbased detected cases of COVID-19. The training of the CNN model was partly impaired by the availability and access to COVID-19 images. [7]

## III. PROBLEM DEFINTION

In efforts for regulating spreading of corona virus, an outsized percentage of suspicious cases needed to be examined for the correct medical and

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quarantine to people.
Fast & accurate techniques are badly required to overcome this pandemics situation.
During this pandemic situation creating model that diagnosis covid-19 and gives quick and more advantages to people for social distance, as covid virus attacks epithelial cells that are present in tracks of lungs, we are in this creating model that identifies these cells and predict he is positive or not.
As the project main motive to save life's, accuracy takes important role for doing this, so by adding more X-ray images for training the model and performing more iterations on the model, the Deep Convolutional Neural Network (DCNN) accuracy are often improved more for the model.

## IV. PROPOSED WORK

Deep- Convolutional Neural Networks (CNN): The proposed method uses Deep Convolutional Neural Networks to detect the corona virus based on the Chest X-Ray images. The proposed model involves the following stages:

Pre-Processing: In the first stage, lung regions are extracted from CT image and in that region each slice is segmented to get tumors.

Convolutional Neural Networks (CNN): A CNN is composed of several kinds of layers:
Convolutional layer: creates a feature map to predict the class probabilities for each feature by applying a filter that scans the whole image, few pixels at a time.

Poolinglayer (down-sampling): scales down the amount of information the convolutional layer generated for each feature and maintains the most essential information (the process of the convolutional and pooling layers usually repeats several times).

Fully connected input layer: flattens the outputs generated by previous layers to turn them into a single vector that can be used as an input for the next layer.

Fully connected layer: Applies weights over the input generated by the feature analysis to predict an accurate label.

Fully connected output layer: Generates the final probabilities to determine a class for the image.

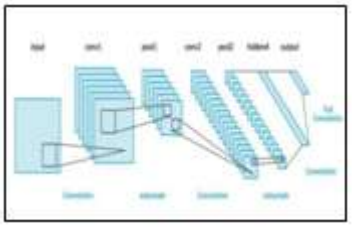

Figure 4.1 : Convolutional Neural Network General Architecture

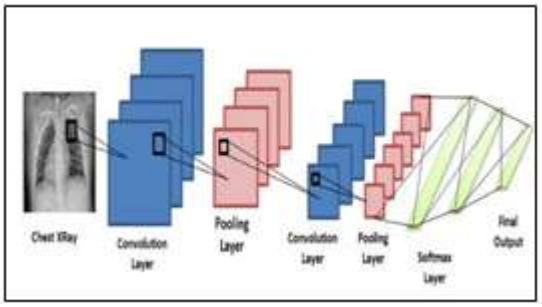


Figure 4.2:Architecture of CNN diagram of Proposed Method

## V. METHODOLGY AND IMPLEMENTATION

To confirm the proposed method, we need two types of chest x-ray images which are a normal x ray and one x-ray image of a patient affected due to covid. Although chest X-ray images of the common category were collected in the Kaggle database containing other images selected from the Chest X-ray database. To offer a significant number of patients with COVID-19 worldwide, but online x-ray images accessible are less important and scattered. Kaggle Chest X-ray data is a well-known remote site that contains common or healthy, viral, and bacterial-pneumonia X-ray images. The beautiful and trusting images of CORONA VIRUS were found in the open source software. Common X-ray images of pneumonia and pneumonia were used in this circle to compile the latest website collection.

This model aims to classify a given X-ray image of a given chest into a single phase or COVID-19 comprising a few different stages of collection, pre-processing, feature selection, feature extraction, training. Detailed information for each category will be provided in the following sections. The first stage comes together, in this process we can collect all the x-ray images which contain both covid and non-covid x-ray images

Pre-processing refers to all image modification before it is fed to the machine,

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training CNN in photography. Strategies Provided in Preliminary Data Processing. Data Cleaning. Cleaning "dirty" data. Real-world data is often imperfect, inconsistent and noisy. Data Consolidation, Consolidation of Data from Multiple Sources, Data Conversion. Building a data cube, Data reduction. Reduce data set representation. Often incomplete data leads to the exchange of sound that affects the remaining part of the data containing x-ray attributes. An optional algorithm can be seen to introduce new features of sub-sets, as well as a guessing scale that tells the various details of the sub-sets. Feature selection is used to make models easier for users to interpret, and is used to improve performance by minimizing performance, avoiding the curse of size.

## VI. IMPLMENTAION

Modern computer programs are easy to use. User interaction is not limited to console-base I / O. They have an ergonomic graphical user interface (GUI) for high-speed processors and powerful graphics hardware. These applications can get input with the click of a mouse again can allow the user to choose alternatives with the help of radio buttons, drop-down lists, and Some GUI features.

Tkinter Programming:

Tkinter is a standard Python GUI library. Python when combined with Tkinter provides a quick and easy way to build GUI applications. Tkinter provides a powerful object-focused object interface of the Tk GUI Toolkit. Tkinter has several strengths. Cross-platform, hence the same code works on Windows, macOS, and Linux. Material is provided using traditional functionality system components, so applications built with Tkinter seem to belong to the platform there they run:

To create the tkinter application:

1. Introducing the module – tkinter

2. Create a large window (container)

3. Add any number of widgets to the main window

4. Use the Event Trigger in widgets.

## VII. RESULTS AND DISSCUSION

A convolution layer extracts the features of the input images by convolution and output is the feature maps. It is composed of many of the fixed sizes and filters which are known as convolution kernels, which is used to perform the convolution layer operations on image data to produce the features of maps. The following images differentiate between normal x-ray vs covid affected x-rays.

Output data: for output label y, the result may return as normal, pneumonia, or COVID-19.

Step1: Batch normalization, preprocessing, augmentation

Step2: Freeze the base layer and add proposed convolution layer with filters=32, input shape=(299,299,3), kernel size= (3, 3), activation: ReLU

Step3: Feed the first residual convolution layer with filters=64, kernel size= (3, 3), activation: ReLU, add Maxpool layer, dropout with rate=0.25

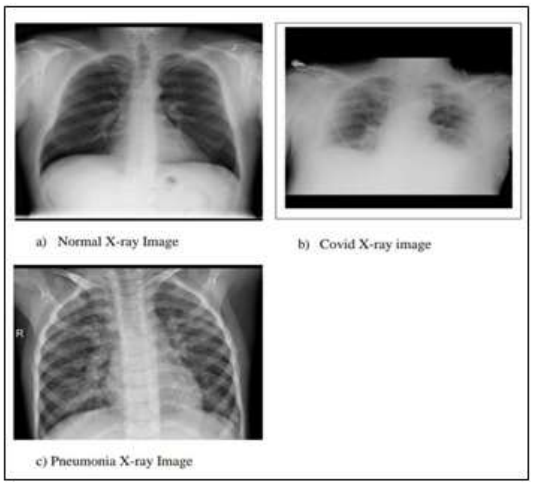


Figure 6.1:Chest x-ray images of normal, covid, pneumonia patient.

| Test case | Module being tested | Sample input | Sample output |
|---|---|---|---|
| 1 | User access | Login details | Home page |
| 2 | Covid detection | X-rayimage | Covid detected |
| 3 | Normal | X-rayimage | Normal |
| 4 | Pneumonia detection | X-rayimage | Pneumonia detected |

Table 6: module tested for i.user access ii.covid detection iii.normal iv.pneumonia detection

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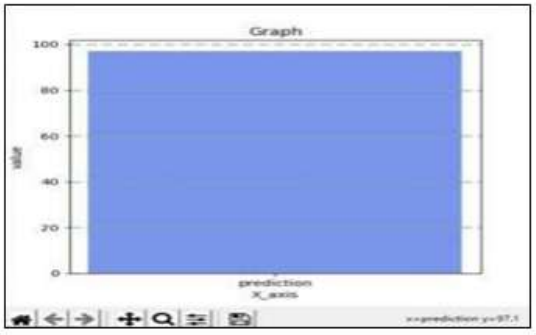


Figure 6.2: Displays value of prediction for covid image

Algorithm
Input data: for CXR real images, let x be input image and y be output label. y = (normal, pneumonia, and COVID-19].

Step4: Feed into the second residual convolution layer with filters=64, kernel size= (3, 3), activation: ReLU add Maxpool layer, dropout withrate=0.25

Step5: Feed into the third residual convolution layer with filters=128, kernel size= (3, 3), activation: ReLU add Maxpool layer, dropout with rate=0.25

Step6: add flatten, dense layer with units=64, activation=ReLU, dropout with rate=0.50

Step7: Finding the accuracy.

## VIII. CONCLUSION

We believe that this computer-aided diagnostic tool can significantly improve the speed and accuracy of diagnosing cases with COVID- 19. This could be highly useful in a pandemic, where the burden of disease and the need for preventive measures do not match the availability of resources. Deep learning has become a dominant method in a variety of complex tasks such as image classification and object detection. The proposed Deep CNN model provides better accuracy and achieves better performance. The results demonstrate that transfer learning proved to be effective, showed robust performance and easily deployable approach for COVID-19 detection. The detection of corona virus pneumonia infected patients using chest X-ray radiographs and gives a classification accuracy of more than 90%. This computer-aided diagnostic tool can significantly improve the speed and accuracy of diagnosing cases with COVID- 19.

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