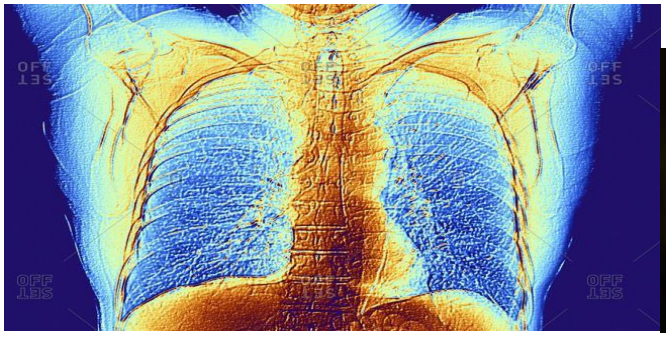
BANGALORE INSTITUTE OF TECHNOLOGY

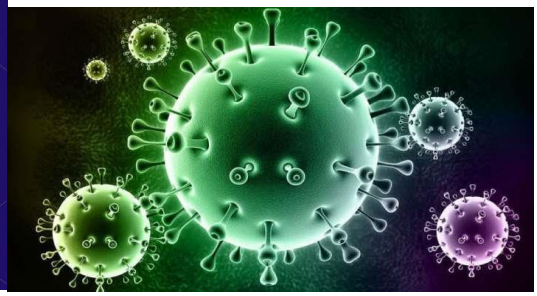
K R road, V V Puram, Bangalore – 04

Department of Computer Science and Engineering

Project Report

"COVID-19 Testing Using X-Ray Images & Web App Development"





USN	NAME	SEM	PHONE NO	E-MAIL
1BI18CS034	B PRAVEEN NAYAK	5	+918310276181	praveennayakbalaji@gmail.com
1BI18CS073	LIKHITH B	5	+917019311822	likhithlekhan@gmail.com
1BI18CS050	DHRUV VARSHNEY	5	+9197735 77033	Dhruvvarshney2612@gmail.com

Problem Domain : *Developing a Deep Learning model (CNN) to detect Corona virus with help of Chest X-rays images and Web App Development.*

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1. Abstract

Current Situation of Coronavirus Disease: (COVID-19)

COVID-19 is a type of coronavirus disease belonging to the family Coronaviridae. The disease is thought to originate from bats and was spread to people through an unknown medium in Wuhan, China. Ideally, the condition is spread by inhalation or close interaction with infected droplets that have an incubation period between two and fourteen days. Today, there are thousands of infections and deaths that have been caused by the disease. Moreover, the symptoms of the disease include fever, cough, sneezing, sore throat, difficulty breathing, and tiredness. Additionally, the diagnosis of the disease starts by gathering samples of the upper and lower respiratory tracts of the infected person. Also, chest X-rays and CT scan are used in the diagnosis stage. Basically, there is no precise treatment for the ailment, and this calls for the need to prevent the disease from spreading. Notable prevention strategies are isolation of the infected persons, proper ventilation, hand hygiene and use of personal protective equipment. Therefore, this project provides in-depth information on COVID-19 as it discusses the disease epidemiology, transmission, clinical features, diagnosis, treatment and prevention.

2. PROBLEM STATEMENT :

Existing process of the getting information of covid-19 x-ray images and Pneumonia normal images is extracted from online available resources. World Health Organization has declared Covid-19 as a pandemic. There are a number of test kits available but are either expensive or take time to detect the virus. Deep Learning is State-of-the-art machine learning algorithm and has shown massive development in detecting Covid-19 with the help of chest X-rays.

In this blog, we will learn to detect Covid-19 with help Chest X-rays using CNN architechture.Thus providing this purpose with necessary functionalities.

3. SOFTWARE REQUIREMENTS SPECIFICATIONS :

Software requirements : Minimum software requirements are:

- Tool : Anaconda, CNN Architechture
- Operating System : Windows XP/7,8,10
- Scripting Language : Python, Flasks
- X-Ray Images : COVID-19, Pneumonia normal

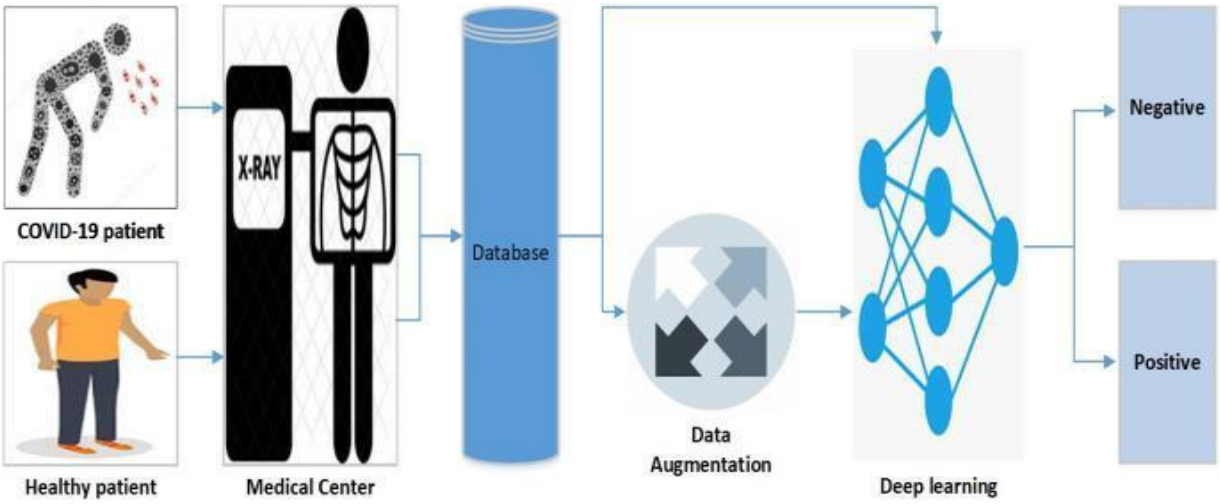
4. System Design

Our proposed deep learning-based COVID-19 detection comprises several phases, as illustrated in Figure. The phases are summarised in the following five steps:

Step 1: Collect the chest X-ray images for the dataset from COVID-19 patients and healthy persons.

Step 2: Generate Chest X-ray images using data augmentation.
Step 3: Represent the images in a feature space and apply deep learning.
Step 4: Split the dataset into two sets: a training set and a validation set.

Step 5: Evaluate the performance of the detector on the validation dataset.



- **DATASET :** COVID-19 images used in training are from, https://github.com/ieee8023/covid-chestxray-dataset

Covid-19 affected chest X-ray

Normal Images

- Dataset: Chest X-Ray Images (Pneumonia),
- https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia
- It has two types of X-Ray images Normal and Pneumonia but only normal X-Rays have been used from this dataset so that Model learns to identify Covid-19 cases.

Normal chest X-ray

- **Importing the required libraries :**

```
In [1]: import pandas as pd
        import os
        import numpy as np
        datapath1 ='C:\\Users\\dhruv\\OneDrive\\Desktop\\covid19xray\\covid-chestxray-dataset-master'
        dataset_path = 'C:\\Users\\dhruv\\OneDrive\\Desktop\\covid19xray\\dataset'
        categories=os.listdir(dataset_path)
        print(categories)
        dataset = pd.read_csv(os.path.join(datapath1,'C:\\Users\\dhruv\\OneDrive\\Desktop\\covid19xray\\covid-chestxray-data
        findings = dataset['finding']
        image_names = dataset['filename']

        ['Covid19 Negative', 'Covid19 Positive']
```

- **DATA Exploration :** The metadata.csv has the information about the data ie. data about data.

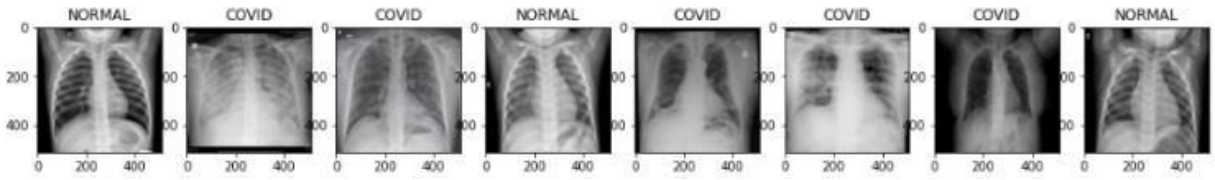
	Patientid	offset	sex	age	finding	survival	view	modality	date	location	filename
0	2	0.0	M	65.0	COVID-19	Y	PA	X-ray	2020	NaN	auntminnie-a-2020_01_28_23_51_6665_2020_01_28_...
1	2	3.0	M	65.0	COVID-19	Y	PA	X-ray	2020	NaN	auntminnie-b-2020_01_28_23_51_6665_2020_01_28_...
2	2	5.0	M	65.0	COVID-19	Y	PA	X-ray	2020	NaN	auntminnie-c-2020_01_28_23_51_6665_2020_01_28_...
3	2	6.0	M	65.0	COVID-19	Y	PA	X-ray	2020	NaN	auntminnie-d-2020_01_28_23_51_6665_2020_01_28_...
4	4	0.0	F	52.0	COVID-19	NaN	PA	X-ray	2020	Changhua Christian Hospital, Changhua City, Ta...	nejmc2001573_f1a.jpeg

metadata

- **Loading the image data :**

  We will first extract all the image paths and use the imread method of the openCV library to load the images. Then we will convert the images into RGB channel and resize the images to 100 X 100 pixels.

  We will then Normalize our data by converting the pixel intensities in the range of [0,1].



X-Ray Dataset

- **Splitting the data set** : Here, we will split the data into training. testing and validation sets.

- **Data Augmentation :** To help the model generalize and improve we perform Data Augmentation and thus increase the diversity of our data.

5. Model Building

Here, we can start building our **CNN** architecture. We have used the VGG16 network with weights pre-trained on ImageNet and added our own layers to construct the final model. The optimizer used is Adagrad with binary crossentropy as the loss function and accuracy as the metrics.

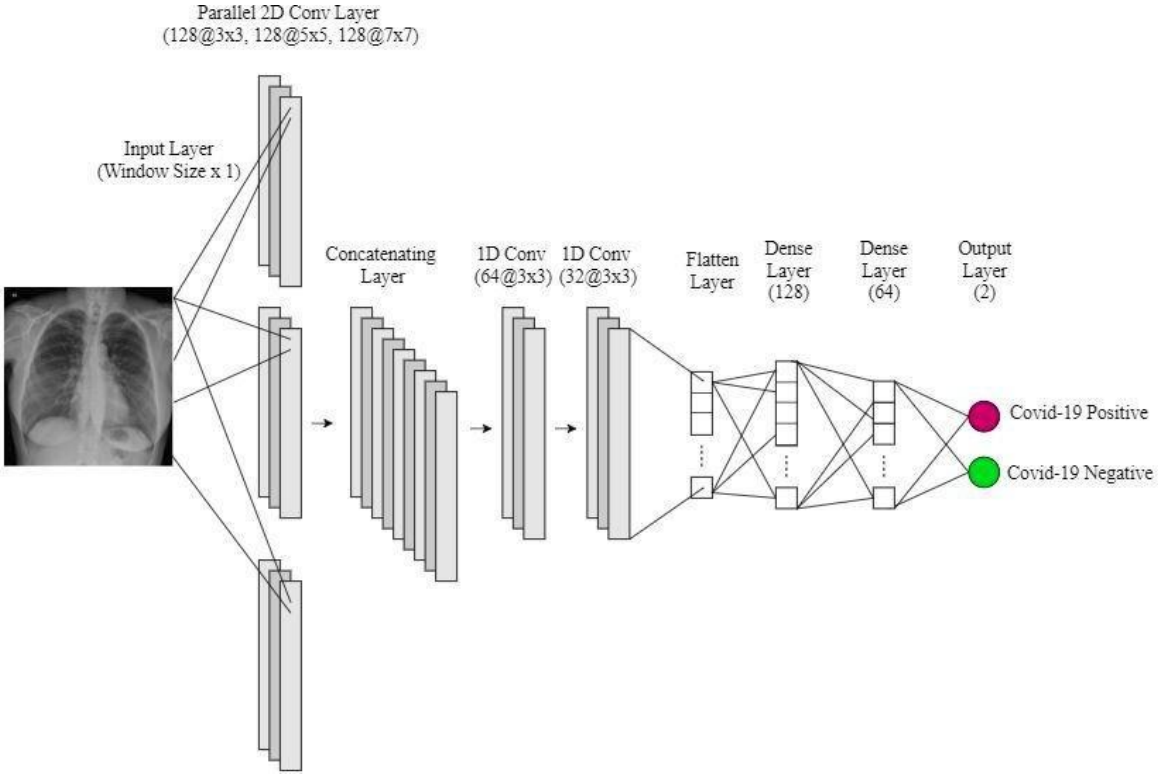
What Is a Convolutional Neural Network?

A Convolutional Neural Network (CNN) is a deep learning algorithm that can recognize and classify features in images for computer vision. It is a multi-layer neural network designed to analyze visual inputs and perform tasks such as image classification, segmentation and object detection, which can be useful for autonomous vehicles. CNNs can also be used for deep learning applications in healthcare, such as medical imaging.

How a Convolutional Neural Network Works—The CNN layers

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.
- **Pooling layer (downsampling)**—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.



Convolutional Neural Network Architecture

6. Results

In this section, we discuss the loss observation, followed by the results of model validation. We performed experiments to detect and classify COVID-19 confirmed cases using X-Ray images and train the models in two classes: non-COVID and COVID-19. The model was evaluated using 10-fold cross-validation technique. We have used 90% of X-Ray images for training, and the rest of the 10% are used for testing or validation. Moreover, the loss function is highly essential to understand the excellence of the prediction. from Figure, we observe that the training loss and validity loss is decreased gradually after every 20 epoch.

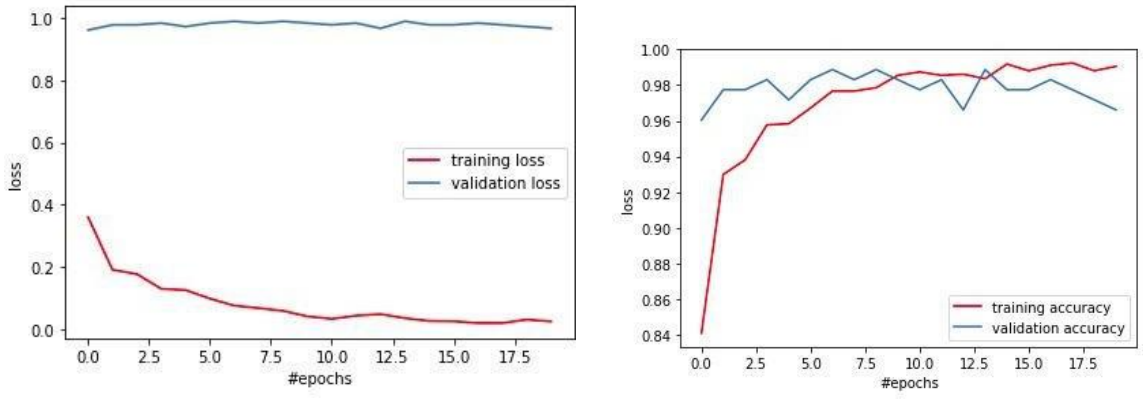


Figure illustrates training, validation loss and accuracy after every 20 epoch

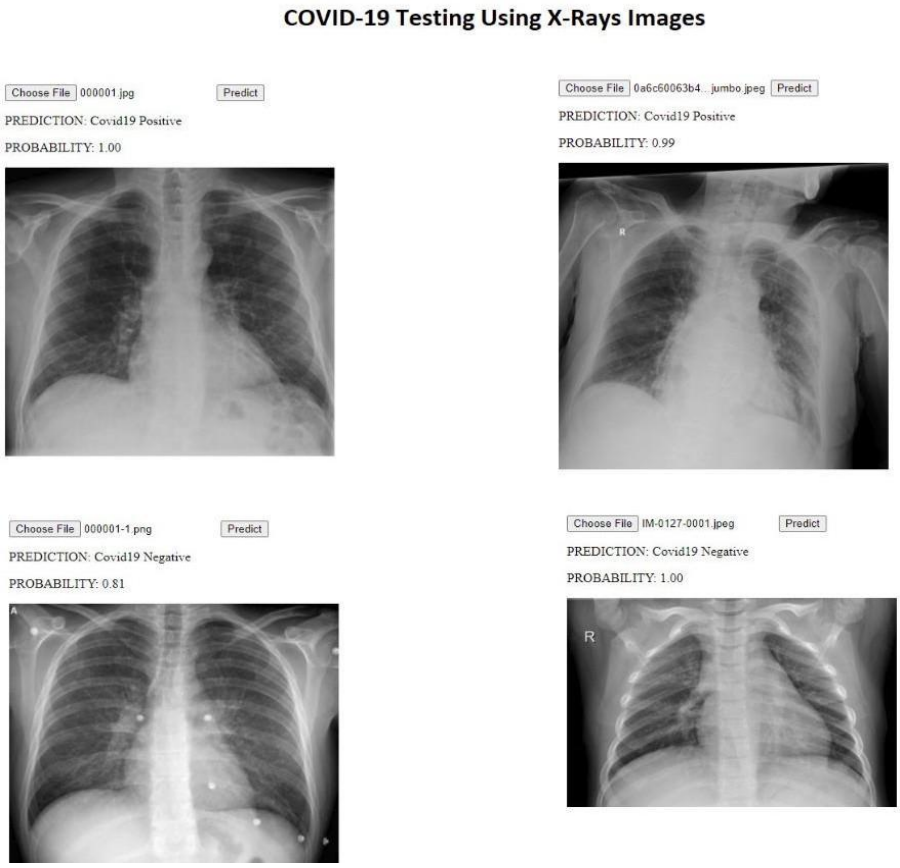


Figure shows COVID-19 testing using x-ray images under web app development

7. Applications : Proposed approach and its advantage over existing system

- Implementation is easy.
- Gives the positive results for other diseases.
- Trains the CNN (Convolutional Neural Network).
- Integrate and train the CNN into a web application using python & flask.
- Performs preprocessing and normalising x-ray images.