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COVID-19 DETECTION MODELUSING DEEP LEARNING

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ABSTRACT

Today the pandemic COVID-19, has resulted a massive outbreak in over 150 nations around the world, with serious health consequences. In the nations where the laboratory kits are unavailable for testing, it is becoming even more critical. So, in order to detect COVID-19 disease we have investigated a model that is built based on image processing and deep learning techniques. A COVID-19 infection can progress to pneumonia, which can be identified with a chest X-ray exam and treated according to that. As, the number of COVID-19 victims are increasing day by

day this needs to be done very quickly. Here, we created a model with X-rays. The chest Computed Tomography (CT) COVID-19 images are collected first, and then the dataset is loaded. We present point processing approaches, apply Image Augmentation, and then use CT scans to determine COVID-19 positivity or negativity (chest x-ray images). Image processing and deep learning approaches.

INTRODUCTION

The major COVID-19 disease originated from Wuhan, China and spread to different parts of the world resulting in an epidemic. Keeping in mind about the availability of the laboratory kits that are needed to test the disease i.e., it is not so easy to test everyone as we are lacking in the test kits, so we are introducing a model based on image processing and deep learning which aims to detect the patients whether they are infected with corona virus or not using the chest X-ray images. Although hospitals are expected to do rapid COVID-19 testing at the point of treatment, every country will not have access to the test kits that produce findings promptly. The cost of laboratory kits required for diagnosis is a significant concern while fighting the disease, especially in developing and undeveloped countries. We use chest x-ray images in order to detect the COVID-19, which is useful for many countries and hospitals which does not have the access to the laboratory kits. We anticipated that deep learning techniques may be used to automate the CT scan picture classification process. To identify CT scan pictures based on their attributes, we created a CNN model. This will assist shorten the time it takes to diagnose COVID-19.

RELATED WORK

Artificial intelligence approaches have repeatedly given base accurate and dependable outcomes in applications that use image-based data. Using deep learning techniques, researchers have been investigating and analyzing CT Scan images to identify COVID-19 in recent times.
The images were normalized to extract enhanced features, which were then fed into image classification algorithms utilizing deep learning techniques. Three CNN systems FPN, Xception, and ResNet50V2, on a transfer-learning scenario, were tested to detect COVID-19 from CT Scan images.

A CNN model was proposed in this study with end-to-end training. A dataset containing 180 COVID-19 and 200 normal (healthy) CT Scan images was used in the study's experimentation. A classification accuracy of 91.6% was achieved as the performance measurement of the study.

The majority of the published research have utilized CT Scan images to detect COVID-19, emphasizing the value of CT Scan image analysis as a reliable tool for doctors and radiographers. However, it is known that neural network models require a large amount of data in order to be trained and tested. In recent studies researchers have worked with a small number of CT Scan images (75–6200 data) for training and testing purposes of COVID-19 detection and achieved varying accuracy (89.2–98%). However, due to the lack of proper training of the models primarily because of using such limited datasets, the credibility of the outcome is questionable. Furthermore, in the studies the models were trained on a large dataset (7470–79,500), which are considered reliable but did not provide accuracies in high nineties, being mostly between 91.5–95.7%. The studies also did not reflect on the compilation time of the implemented models, therefore the most efficient model could not be confidently identified either. Detecting COVID-19 in patients requires not only a highly accurate method but a fast and reliable one as well. To address this issue, a modified ResNet50V2 model is proposed that provides a higher accuracy rate in the shortest time compared to any existing CNN models. To achieve a large dataset for training and testing the model, 13,808 CT Scan images of COVID-19 patients and healthy individuals were augmented to create a dataset of 52,000 images.

SYSTEM DESIGN

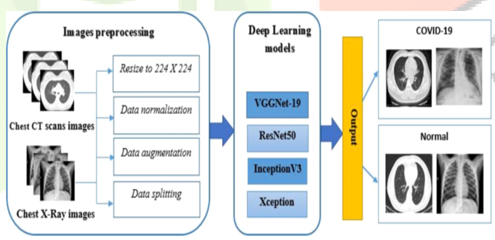


Fig: An overview of system design

Detection of COVID-19 using the ResNet50 model:
ResNET, short for Residual Networks, is a deep neural network used for many computers vision tasks. Its development took place in 2015 when it won the ImageNet competition. It is seen as a continuation of deep networks that revolutionized the CNN architectural race by introducing the concept of residual learning into CNNs and put developed an effective methodology for the training of networks.The proposed method for detecting COVID-19 using the ResNet50 model is shown in Figure. It is primarily made up of residual blocks. The hidden layers of shallow neural networks are linked to each other. However, there exist connections between the residual blocks in the ResNet architecture. This means that each layer should flow into the next, with a space of around 2 to 3 swings between them.

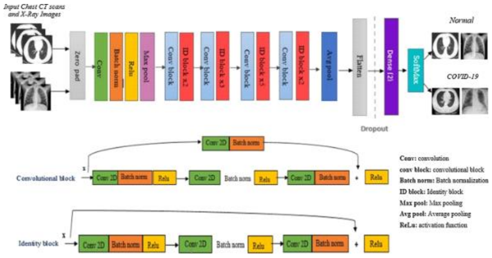


Fig: The detection of COVID-19 using the ResNet50 model

The main advantage of residual connections in the ResNet architecture is that the connections preserve the knowledge gained during training and speed up model training time by increasing network capacity.

Detection of COVID-19 using the InceptionV3 model:

The "Inception" module is introduced by Szegedy et al. In 2014, they published the article "Deeper Convolution". The first module's goal is to operate as a "multi-level feature extractor" by performing 1 × 1, 3 × 3, and 5 × 5 convolutions within the same network module. These filter's output is stacked with the channel size before being fed into the network's next layer.

In terms of computational effort, Inception architectures are less demanding than VGGNet and ResNet (i.e. less RAM is needed to use this framework). Despite this, it turned out to be a high-performing system.The proposed method for the detection of COVID-19 using the Inception model is shown in Figure.

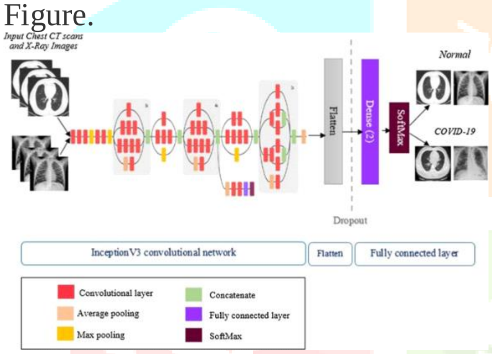


Fig: The detection of COVID-19 using the InceptionV3 model.

Detection of COVID-19 using the Xception Model:

Xception is a new structure proposed by François Chollet in 2017. Xception is considered as an extension of the Inception architecture, where the Inception modules are replaced by convolutions separable in depth.

Except for the first and last modules, the network comprises 36 convolutional layers that serve as the foundation for extracting the network's features.The network is arranged into 14 modules, each of which has linear residual connections surrounding it.

In the Xception architecture, using residual connections will result in faster convergence and better overall performance.

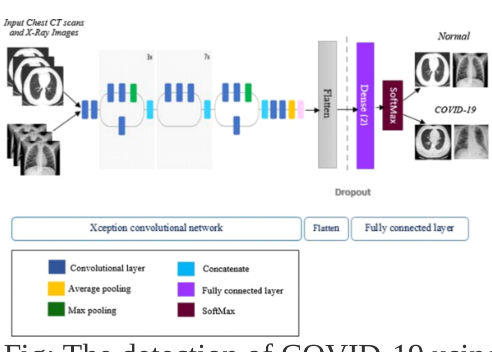


Fig: The detection of COVID-19 using the Xception model.

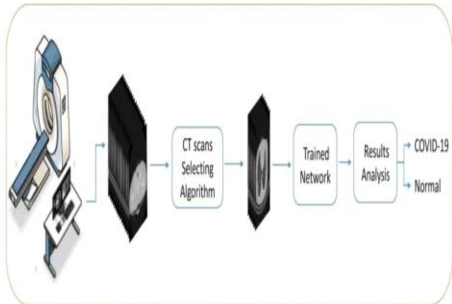
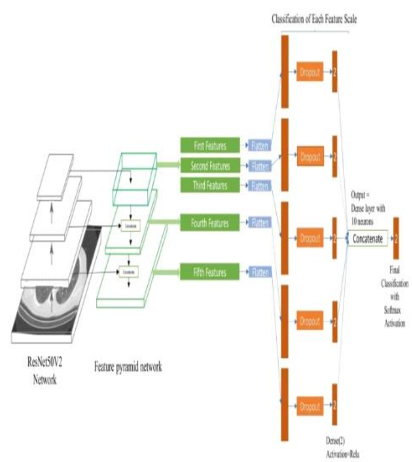


Fig. 1.1: Overview of Architecture

A general overview of our work in this paper is presented in Fig. 1.1 using existing in-depth study networks, identified COVID-19 in CT Scan images and reported high accuracy. by integrating Xception and Resnet50v2 networks with use X-ray images of the chest, able to diagnose normal patients, pneumonia, and COVID-19, with a total accuracy of 99.5, were available tested on 11,302 photos.

Detection of COVID-19 using the ResNet50 with FPN model:

Now coming to technical aspects it is not like a normal machine learning model, our proposed model which is resnet50 with FPN is way more powerful in extracting more information from the samples and way more efficient in giving accurate results. Not only this our proposed CT-Scan algorithm will also the whole model very good in predicting.The threshold value which is proposed in the CT-Scan algorithm is uncertain when it comes to the orientation and other aspects of ct-scan images instead of the proposed method.



DATASET:

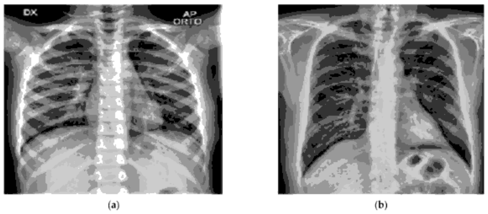
The HRCT pulmonary scan device captures a sequence of images from the chest of a patient who wants to test for his or her infection in COVID-19.

The data set contains 48,260 CT scan images from 282 normal persons and 15,589 images from 95 patients with COVID-19 infections.

EnsNet, a system for scene-text removal, was used to remove annotations from certain images.

EnsNet is capable of automatically removing all of the text or annotation from an image without any prior knowledge.

However, only COVID-19 (3616) and healthy (10,192) X-ray images were extracted for this study. As a result, the dataset includes studies of COVID-19 and healthy individuals with a matrix resolution of 299 × 299 (two X-ray examples are shown in Figure).



Chest X-ray image data samples. (a) Healthy; (b) COVID-19.

Pre-processing and Data Augmentation:

The pre-processing techniques are the useful solution to remove unwanted noise and prepare the input data to be compatible with the requirements of our model.Our original images include RGB coefficients ranging from 0 to 255, but these values are too high for our models to comprehend (given a typical learning rate), so we aim for values between 0 and 1 by scaling them to 1/255.We use data augmentation techniques to artificially boost the amount of our training data because our data collection is rather small. The increase in data is an often applied DL method that generates the required number of samples. It also improves network efficiency for a small database by optimizing it.Data augmentation and image enhancement techniques are performed to enhance the quantity and variety of images given to the classifier for classification. Image augmentations used include horizontal flip, rotation, width shift and height shift on all the extracted data from the original dataset. As chest X-ray images are not vertically balanced, vertical flip was not applied.All augmentation parameters are shown in the below table. After image augmentation, the dataset was increased to a larger dataset consisting of 26,000 COVID-19 and 26,000 healthy chest X-ray images.

Augmentation Technique	Range
Horizontal flip	True
Rotation range	10
Width shift range	0.1
Height shift range	0.1
Vertical flip	False

Dataset splitting:

The N-CLAHE algorithm was then used to normalize pictures and highlight smaller features for machine learning classifiers to notice. Thereafter, the images were scaled down to the classifier's standard resolution (for instance AlexNet was 256 × 256 pixels, whereas GoogLeNet was 224 × 224 pixels).After resizing the picture, the machine learning classifier used the enhanced (52,000) images in a ratio of 80% data for training, whereas 20% was used for testing. Below Table shows the details of the dataset.

Features	Values
Total Number of Images	52,000
Disease Types	2
Dimension (Size in Pixel)	Classifier's Resolution (i.e., AlexNet is 256 × 256 pixels)
Color Grading	Grays, Cyan, Spectrum
COVID-19 Images	26,000 (After Augmentation)
Healthy Images	26,000 (After Augmentation)
Training Images	41,600
Testing Images	10,400

RESULTS

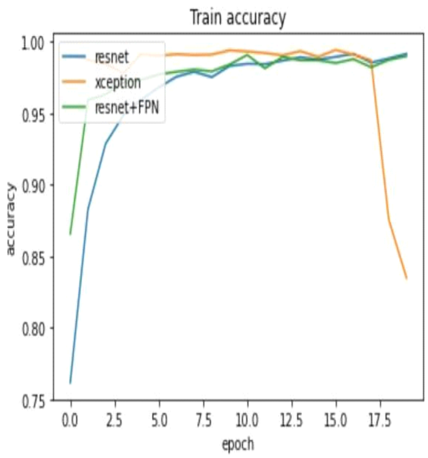


Fig 2.1:Train_Accuracy epoch(comparision graph)

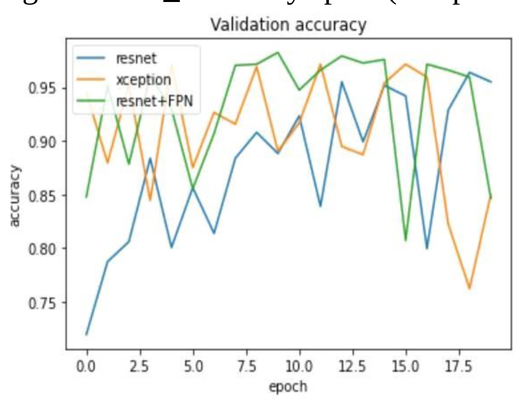


Fig 2.2:Validation_Accuracy vs epoch(comparsion_graph)

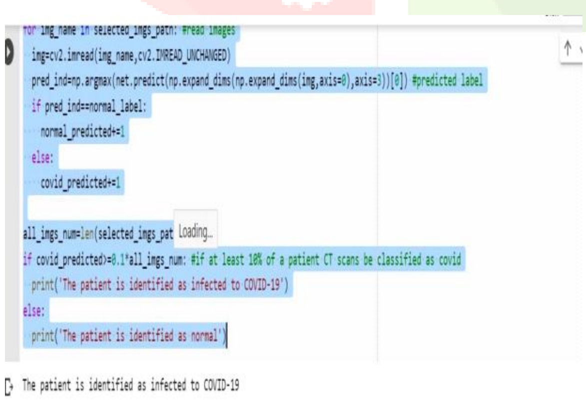


Fig 2.3:output_preview

```
  img=cv2.imread(img_name,cv2.IMREAD_UNCHANGED)
  pred_ind=np.argmax(net.predict(np.expand_dims(np.expand_dims(img,axis=0),axis=3))[0]) #predicted label
  if pred_ind==normal_label:
    normal_predicted+=1
  else:
    covid_predicted+=1


all_imgs_num=len(selected_imgs_path)
if covid_predicted>=0.1*all_imgs_num: #if at least 10% of a patient CT scans be classified as covid
  print('The patient is identified as infected to COVID-19')
else:
  print('The patient is identified as normal')
```

```
The patient is identified as normal
```

Fig 2.4:output_preview

CONCLUSION AND FUTURE SCOPE

A binary-classification deep learning model for detecting COVID-19 from CT scans was developed and tested in this study. We tested four deep learning techniques such as VGGNet-19, ResNet50, InceptionV3 and Xception to verify the validity of the proposed system.The results obtained showed that if we consider each modality separately, we can note that the VGGNet-19 model outperforms the best versions of all models and next comes the Xception model.In order to show the feasibility of our approach, we compared the results obtained by our system with other state-of-the-art approaches. Based on the evaluations conducted in this brief, we have shown that the Xception and VGGNet-19 models perform well and provide 89,5% and 90,5% accuracy.

Based on the research findings of our study, we can conclude that our approach will be useful in assisting doctors and health professionals in making clinical decisions in order to locate COVID-19 as soon as feasible and accurately.Indeed, if this system is applied in hospitals, the number of treatments will be reduced and it will contribute to reducing the intervention of the doctor, especially in certain cases which do not require his intervention at all, which will reduce the medical material and those affected.

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