Abstract – COVID-19 has created a drastic situation to the world health and wellbeing of the world. Due to spread out of this disease rapidly, the COVID-19 confirmed cases have increased to over 10 million worldwide. The world was not prepared to face such type of situation and due to this many people lost their lives. There was no proper medicine to treat the disease. The doctors are not aware of the treatment and got confused to give medicines to the affected one's. Due to lack of safety precautions of the people there was rapid increase in the positive cases of COVID-19. Hospitals also ran out of testing equipment to test the patients. This drastic situation lead to introduce the a method to detect the positivity of the patients. As it is a viral infection which contains a set of symptoms many diseases detection method have failed to detect. To overcome this type of situation has lead the software companies to work on classifying the diseases using the software techniques. The proposed approach is evaluating on public COVID-19 X-ray datasets. We have used this because it can achieve high performance and reduction of computational complexity. The dataset which we used int this approach is by international Cardiothoracic radiologist, and others published on Kaggle. Besides, the performance of our proposed CNN classification method for medical imaging has been assessed based on different edge-based neural networks. The proposed CNN model has been trained and tested with a public X-ray dataset, which is recently published for tertiary and normal classification purposes. For the instance transfer learning, the proposed model has achieved 85% accuracy of tertiary classification that includes normal, COVID-19 positive, Pneumonia, Fibrosis, Tuberculosis…etc.

Introduction -Coronavirus disease 2019 (COVID-19) is a contagious disease caused by the virus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019. The disease quickly spread worldwide, resulting in the COVID-19 pandemic[1]. The symptoms of COVID- 19 are variable but often include fever, cough, headache, fatigue, breathing difficulties, loss of smell, and loss of taste. Symptoms may begin one to fourteen days after exposure to the virus. At least a third of people who are infected do not develop noticeable symptoms[1]. Preventive measures to reduce the chances of infection include getting vaccinated, staying at home, wearing a mask in public, avoiding crowded places, keeping distance from others, ventilating indoor spaces, managing potential exposure durations, washing hands with soap and water often and for at least twenty seconds, practising good respiratory hygiene, and avoiding touching the eyes, nose, or mouth with unwashed hands[2][3]. The WHO has thought of introducing a new technology to know the health condition of the patients through image processing and image classification. In this research we are mainly focusing on image classification which will classify the covid symptoms and covid related diseases like Pneumonia, Fibrosis, Tuberculosis …etc. Here we use the X-ray images of the patients to check whether he is affected with covid or not. In this research we have made use of the google drive as the cloud service to do the implementation. We have collected the dataset from Kaggle(A website where we can able get the datasets for free and can be used for the different types of implementations). The preferred dataset contains of 24,540 CXR images. For our convenience we reduced them to 17,500 CXR images and then we have uploaded them into the google drive. In this we used a deep learning model to train the dataset to predict the disease using the CXR images. We have use GoogleNet CNN model int this research where as GoogLeNet is a convolutional neural network that is 22 layers deep. You can load a pretrained version of the network trained on either the ImageNet or Places365 data sets. In today's world, we use GoogleNet for various Computer Vision applications, including Object Detection, Image Classification, etc[4].

Actually we are using Inception_V3 model which the main novelty in the architecture of GoogLeNet is the introduction of a particular module called Inception. Inception v3 is a convolutional neural network for assisting in image analysis and object detection, and got its start as a module for GoogLeNet. It is the third edition of Google's Inception Convolutional Neural Network, originally introduced during the ImageNet Recognition Challenge. The design of Inceptionv3 was intended to allow deeper networks while also keeping the number of parameters from growing too large: it has "under 25 million parameters", compared against 60 million for AlexNet[4]. The Inception models are types on Convolutional Neural Networks designed by google mainly for image classification. Each new *version* (v1, v2, v3, etc.) marks improvements they make upon the previous architecture. The main difference between the Inception models and regular CNNs are the inception blocks. These involve convolving the same input tensor with multiple filters and concatenating their results[5].

Fig 1 : COVID

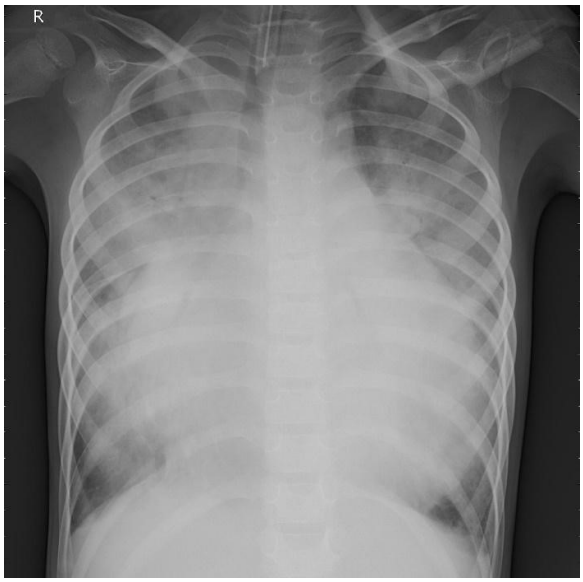

Fig 2 : PNEUMONIA

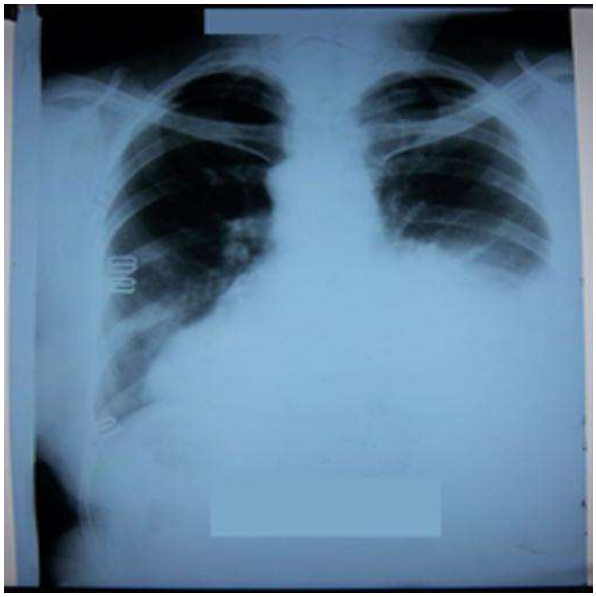

Fig 3 : Tuberculosis

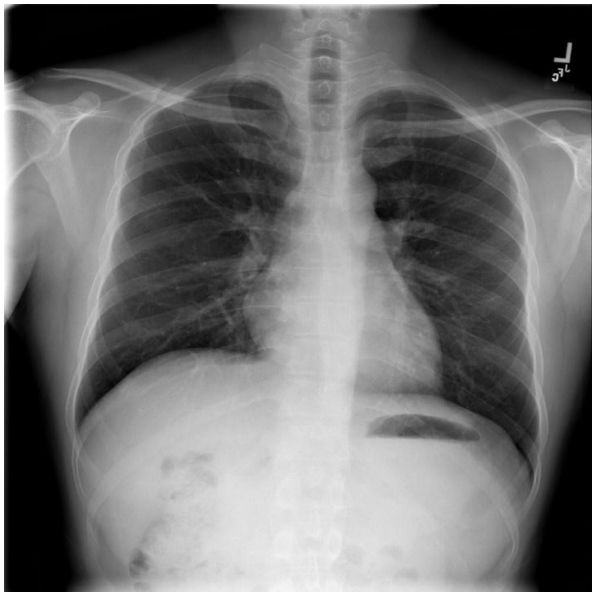

Fig 4 : Fibrosis

Figs 5 : Normal

The above provided images are the images of the patients who are affected with symptoms of the diseases in in COVID-19, Pneumonia, Tuberculosis, Fibrosis, Normal patients.

Literature Review -

Pre-processing of raw medical images

Medical Imaging is the process of creating images of the interior parts for diagnosing various abnormalities in a human body. X-ray and CT imaging are the two often utilized medical imaging modalities for detecting COVID-19. But due to the low intensity and contrast in images, the borders and edges of the images are not clear which may lead to a false diagnosis of the disease. So there is a strong need to pre-process the medical images to extract the essential information and remove the irrelevant data to increase the accuracy of the model . Medical image processing deals with the application of an algorithm on a digitized image to enhance the image quality of the raw medical data for further analysis. Various pre-processing techniques are used in medical imaging applications to improve the visual information of the input image. Image resizing, image segmentation and image enhancement are the usually performed pre-processing techniques in X-rays and CT scans in COVID-19 diagnosis[7].

Image Resizing

It is necessary to standardize the dataset as it is acquired from multiple centers and scanners which may vary in size. All the images in the dataset are generalized to a fixed dimension using the image resizing technique for better classification performance of the CNN model [8].

Image Segmentation

Image segmentation is a commonly used technique in digital image processing and analysis to partition an image into multiple parts or regions, often based on the characteristics of the pixels in the image[9].Image Segmentation is an essential image processing technique to increase the prediction quality and reliability of the model. Segmentation focuses on the Region of Interest (ROI) and for COVID-19 detection the ROI is the lung region. It reduces the computational complexity by separating the lung region from other background information in the medical images . Fig. 1. shows samples for image segmentation.

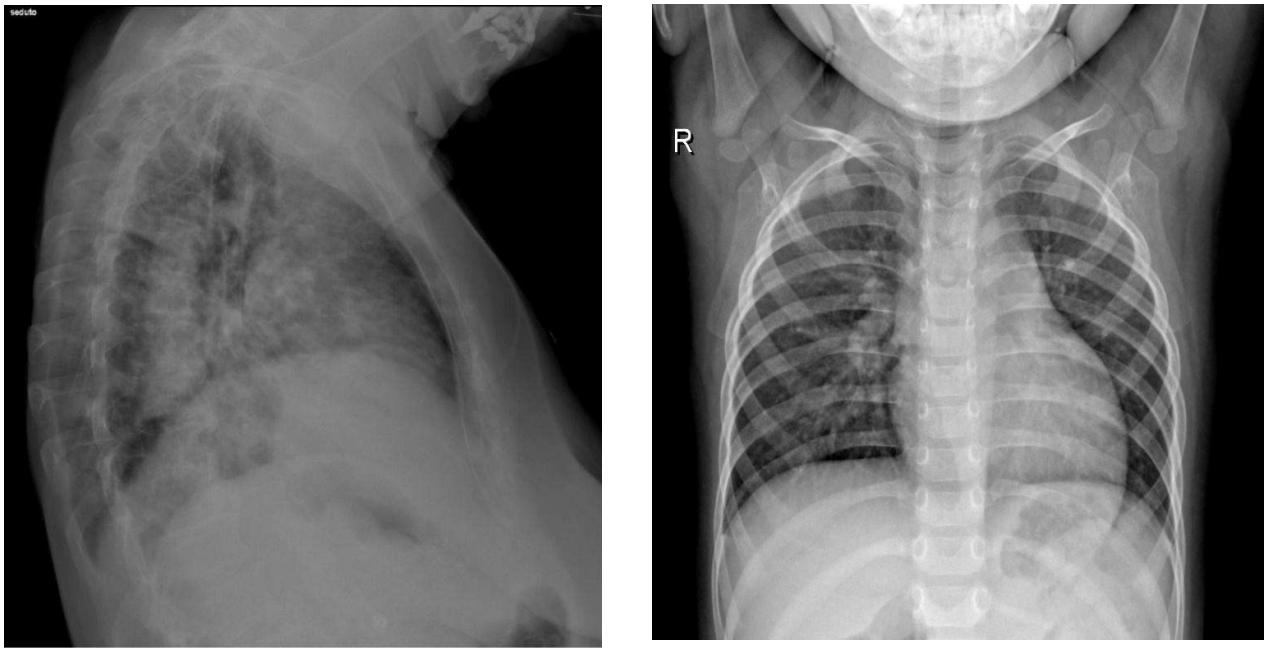

Fig. 1. Samples for Image Segmentation

Image Enhancement

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features[10].Image Enhancement is essential for enhancing the visual perception quality of the medical images for disease diagnosis. Histogram equalization is an enhancement technique that distributes the intensity level over the pixels of the image. In some cases, the information carried by the white pixels is washed out due to the high contrast in the white region . Adaptive Histogram Equalization (AHE) distributes the intensity values only on the small regions of the image. It may result in over-amplification of noise within the homogeneous regions . CLAHE (Contrast Limited Adaptive Histogram Equalization) limits the over enhancement of noise caused by AHE. It enhances the image by fixing a maximum contrast limit beyond which the contrast cannot be improved that prevents over-amplification of noise . Alaa S. Al-Waisy et.al have used CLAHE to enhance the image contrast and improve the visibility of the borders of the chest X-ray images . Samples for image enhancement are shown in fig. 2.

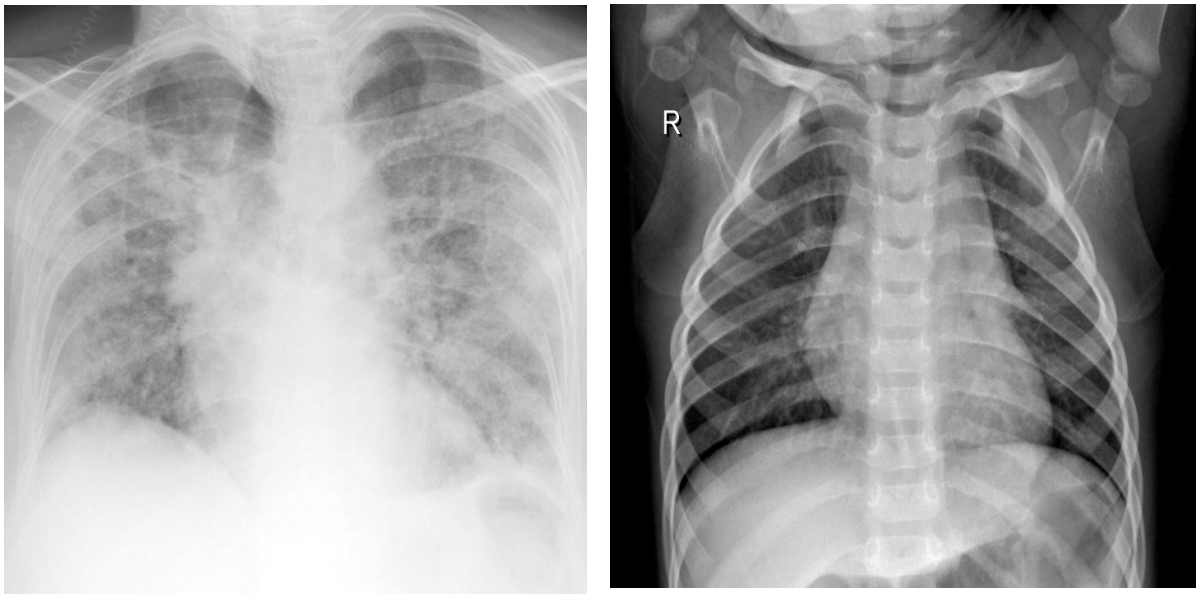

Fig. 2. Samples for Image Enhancement

Data Sets

Deep learning requires a large amount of data for the model to be trained efficiently and accurately. The data available in the dataset are split into three sets:

i) Training dataset
ii) Validation dataset
iii) Test dataset.

The training dataset is used during the learning process to train the model to perform tasks. The validation dataset is used to evaluate, fine-tune model hyperparameters during the training process and facilitates in optimizing model selection. The test dataset is used to assess the model once it is completely trained using the training and the validation dataset .

Fig. 3 depicts the typical split of the available dataset. As COVID-19 is an ongoing and new pandemic, the available datasets are insufficient and imbalanced to train the model effectively . To deal with the data scarcity problem two strategies are often used:

- i)Transfer Learning
- ii)Data Augmentation

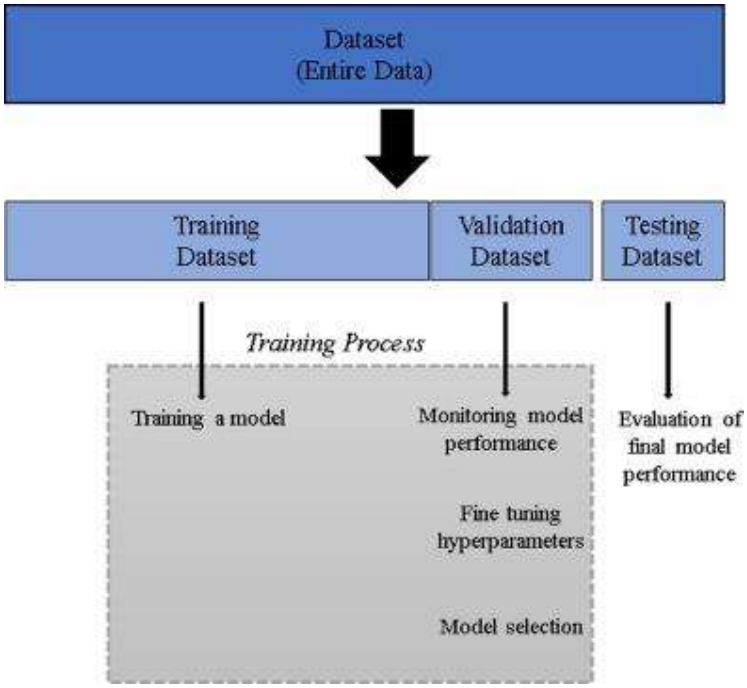

Fig. 3. Split of the available dataset

(i) Transfer Learning

Transfer Learning is an approach where a neural network model trained for a particular task is reused for a model on another task. For the new task, only the layers that are very close to the output units are retrained. The pre-trained model has to be trained with a sufficient amount of data because it gains knowledge about feature extraction of the image which is going to be transferred to another model . The main application of transfer learning is the classification of medical images for emerging diseases due to the limited availability of samples . Transfer learning has the benefit that the training time of the model decreases and is computationally less expensive as only a few layers are retrained. Since the models are already trained, it does not require a vast amount of data. Fig. 4. illustrates the concept of transfer learning. Here the knowledge gained by model 1, which is trained with a large amount of data is transferred to model 2 to perform a related task when the amount of data available to train model 2 is limited[6].

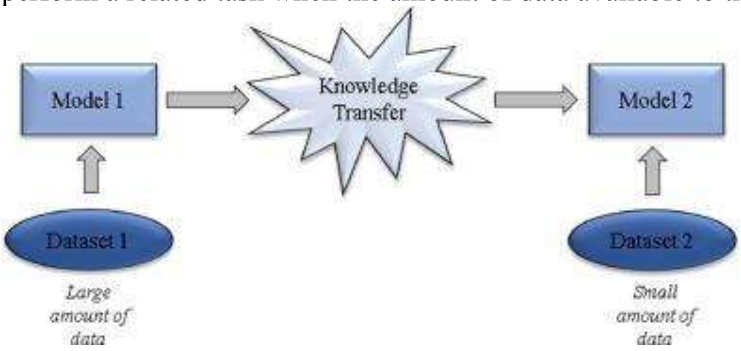

Fig. 4. Transfer Learning Concept

(ii) Data Augmentation

Data augmentation is a technique of artificially increasing the training set by creating modified copies of a dataset using existing data. It includes making minor changes to the dataset or using deep learning to generate new data points[11]. Data augmentation is another strategy that overcomes the data scarcity problem. It increases the number of samples in the dataset by making slight variations in the already existing samples. For instance, Soumya Ranjan Nayak et al augmented the training X-ray images by rotating them by an angle of 5˚ clockwise, scaling them by a measure of 15%, flipping the images horizontally and adding

Gaussian noise with a mean of 0 and variance of 0.25 . In their 18-way data augmentation Shui-Hua Wang et al added speckle noise to the training Chest Computed Tomography (CCT) images with a mean of 0 and variance of 0.05. Data augmentation helps to reduce overfitting and serves as a regularizer. Augmenting the dataset can also increase the accuracy of the model.

Methodology

During the research we used a deep learning model to predict the disease. At present, the commonly used deep learning models are sparse model, restricted Boltzmann machine model, and convolution neural network model. Although these models have some differences in feature extraction, they have similarities in image classification and recognition[12].In our research we used convolutional neural network model to classify the diseases.

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