Pneumonia detection with flask using deep learning model

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Abstract - **Pneumonia is dangerous & rapidly spreading disease caused by bacterial, viral, fungi infections. If early care or treatment and detection are not done then, this disease becomes a critical disease . It causes a number of deaths when proper care is not taken especially in kids whose age is below 5 years and adults whose age is above 65. Pneumonia detection is a web app created in a flask with the help of transfer learning techniques. The main purpose behind this paper is to reduce the overload of the radiologist to detect pneumonia and produce an accurate result in case of fluid or liquid material in the chest-Xray also. In this research models used are CNN, Dens Net, VGG16, ResNet50, Inception Net. All 5 models are trained with 30 epochs and amongst all the models Dense Net gives 94.00% accuracy which is higher than the other 4 models. So, Dense Net is used to load the model and deploy the model into the flask app to detect pneumonia.**

Index Terms - Deep learning, Dense Net, flask, Chest-Xray

INTRODUCTION

Pneumonia is the most dangerous and rapidly spreading disease in kids below the age group of 5 and in adult people whose age is more than 65 as they have less immune power. Pneumonia can be caused by an infection that may be of bacterial, viral, fungi. If anyone has chest pain while breathing or difficulty taking a breath while coughing if phlegm or mucus is generated a loss of appetite, fever, sweating & chills, Nausea, vomiting & diarrhea like symptoms then he or she may get infected by pneumonia.

Pneumonia can be prevented by using antibiotics in case of pneumonia is of bacterial type and antiviral drugs or vaccines are used in case of pneumonia is of viral type. Early detection can save more lives.

Chest-X ray method is the best method among other techniques like MRI and CT scan as MRI & CT scan requires more cost than X-ray and instruments and machinery required for the Xray are easily available all the overworld as its cost is less and it can be handled easily by less trained experts also. There are some less developed countries in which MRI, CT scan facilities are not available due to costing and trained individuals are less in numbers. While detecting pneumonia through chest X-ray some complexity may occur due to fluid, pus, or other liquid in the chest that comes in Chest-Xray so prediction of radiologist may be wrong in such cases there may be a necessity of computerized system which will handle all the cases neatly and reduce the workload of the radiologist to detect pneumonia with great accuracy. Due to Pneumonia disease, one or both lungs can infect. In pneumonia oxygen storage and taking oxygen for respiration is decreased.

Pneumonia is infected by nearly 450 million people all over the world & finally get 4 million deaths per year due to pneumonia(Wikipedia). A number of researchers started with the CNN model for image recognition tasks like disease detection using an image but as per the researcher does it is proved that pre-trained models or transfer learning techniques like DensetNet, VGG16, ResNet50, Inception Net gives the more accurate result and are used to detect the Pneumonia & by comparing all the models the best model which gives the highest accuracy that model is selected to detect pneumonia. Pneumonia detection using web app with transfer learning technique is used in this research.

RELATED WORK

Most of the researchers does research on pneumonia detection but most of them used machine learning algorithms to detect pneumonia afterwards, Abeyratne et al [9] proposed model were used for diagnosing pneumonia by using cough sounds they use logistic regression classifier.

Luján-García and Juan Eduardo et al [5] In this paper author proposes pre-trained CNN models in conjunction with Xception network as a pretrained model on ImageNet & pre-processing technique is used for increasing the performance. This network has 36 convolution layers, a dropout of 0.25, and optimizer adam is used to minimize the loss. Precision score got is 0.843, recall score of 0.992 F1 score of 0.912, AUC score 0f 0.962 for ROC curve & AUC score 0f 0.973 for precision-recall curve. The proposed model is 5.4 to 6.7 faster compared with baseline models.

Faizabadi Ahmed et al [7] In this paper ResNet 50 architecture is used to detect pneumonia on two different datasets that is Chest X-ray image dataset and the RSNA dataset then the trained model has achieved 96.76% accuracy. The main goal of this paper is to develop an effective model to classify pneumonia using chest x-ray On the RSNA dataset 96.76% accuracy got whereas on the chest Xray dataset 94.06 % got. RSNA requires less time for training as compared to chest Xray dataset.

Khan Maseeh Shuaib et al [10] Author developed a webapp to detect pneumonia using chest Xray from frontal view. Author develops a model to detect multiple diseases using chest Xray

dataset. An efficient model is used to detect diseases & got accuracy of 84%.

Sharvari Kalgutkar et al [1] In this paper author gives more importance On CNN pretrained models like Inceptionv3, ResNet50 & VGG16 depend on transfer learning especially for pneumonia detection. After adding a set of customized neural layers accuracy increased up to 5 %to 7%.VGG 16 gives validation & testing accuracy 94.07% & AUC of 97.96%. The recall of the VGG16 is less compared to ResNet50.ResNet50 shows better performance than other models. It has recall of 98.97% testing accuracy of 93.91% & AUC if 96.94%. After averaging the performance parameters (Precision, recall, loss, accuracy & AUC). Author stated that ResNet50 model preforms the best.

Nusrat Jahan et al [2] In this paper author used a Efficient Net-B2 CNN model with fine tuning to train the model attaining 96.33% test accuracy ,98% precision & 97% recall. Work has generated an F1 score of 0.97 an AUC score of 0.991 for the ROC curve.

Kh Tohidul Islam et al. [3] In this paper author investigated the use pretrained models for feature extraction with old classification methods for pneumonia classification gives better result. Author tried different pretrained models and select only two models for training which gives best result. Author proved that by using concatenated features of these networks as input the performance of traditional classification methods can be improved.

Pranav Rajpurkar et al [4]. Author develops an algorithm Chex-Net to detect pneumonia from frontal view chest x-ray images.The author found that Chex-Net algorithm exceeds average radiologist performance on f1 metric. Author also stated that by using this algorithm one can detect multiple diseases using chest Xray 14 dataset.

Elshennawy Nada M. and Dina M. Ibrahim[6]. In this paper author developed 4 different models by changing the deep learning methods out of that two are ResNet152 & MObileNetv2 and other two are CNN & LSTM. The results demonstrate that our proposed deep learning framework improves accuracy, precision, F1 score, recall, Area Under Curve(AUC) by 99.22%,99.43%,99.44%,99.44% & 99.77% respectively.

Dimpy Varshni et al.[8]: -In this paper author used different pretrained models along with classifier algorithms to detect pneumonia. statistical results stated that pretrained models with supervised classifier algorithm can be very beneficial in detecting pneumonia. In this paper DenseNet169 model is used for feature extraction process. DenseNet169 gives 0.8002 AUC curve accuracy.

RESEARCH METHODOLOGY

3.1 Dataset Collection

Dataset required for pneumonia detection is downloaded from secondary source like well-known website for dataset that is Kaggle.com. The dataset used for this research is Chest-Xray images (Pneumonia) dataset. The dataset consists of mainly 3 folders test, train, val. All three test, train, Val folder contains NORMAL, PNEUMONIA as a subfolder. In Val folder NORMAL subfolder contains 8 images and PNEUMONIA subfolder contains 8 images. Dataset information can be represented via tabulated form is given below. Detail description of the dataset used for this research is shown in Table1.

Srno	train folder		test folder		Val folder	
	NORMAL	PNEUMONIA	NORMAL	PNEUMONIA	NORMAL	PNEUMONIA
1	1341	3875	234	390	8	8

Table:1
Dataset information

3.2. Proposed Model

The detailed proposed model used for this research is shown in below Fig1.
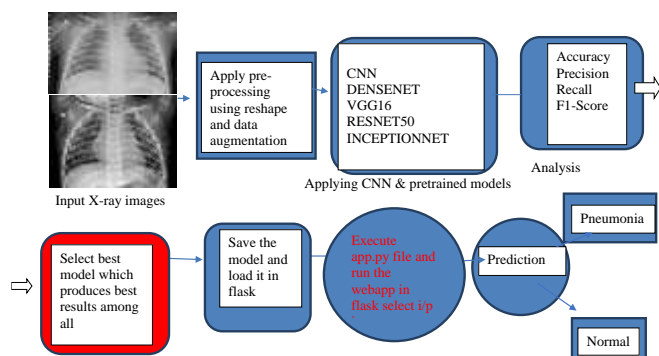

Fig.1
Proposed model for pneumonia detection.

In this research for pneumonia detection 5 models are used like one of them is CNN model and the other 4 are pretrained transfer learning models like DensNet121, Resnet50, VGG16, Inception Net. Chest-Xray images used for this research are of different sizes, so there is need of pre-processing to make all the images in proper sizes so that they can detect disease neatly. In this research reshape layer is added the start of model and Image Data Generator augmentation technique is used to give image transformation in different angles etc. and produce more images to increase images from dataset to give more training data to learn the model neatly and produce best result. This research problem is of binary image classification. So, output produces result either "0" for Normal patient or produces output "1" for Pneumonia patients. In transfer learning some earlier layers are just checking the shape, edges then in the middle stages some more complex shapes of the images is detected and the last layers are more responsible to predict the result. So, final layers are changed to get more accurate prediction. The research started with deep learning approach though machine learning produces best result it requires expertise in selecting the number of features required to train the model neatly. As in the machine learning features has to be selected manually. Whereas, in deep learning the required features are automatically detected. When we talk about image recognition using deep learning then we first use

CNN model as it produces good results so, from CNN model this research is started. Then, as there is another advancement in CNN model are available called pretrained transfer learning models are used like DenseNet121, Resnet50, VGG16, Inception Net etc. For this research flask is used to create the webapp. As, there is huge requirement for websites now a days and anyone can use this webapp anywhere this research is developed using flask. Out of 5 models Res Net 50 produces 95.49% accuracy which is best among rest of the 4 so for this research Reset 50 model is preferred to deploy the model in the flask. Optimization technique used for this research is Adam which produces good result than others. This model can be deployed over cloud system like Heroku, google cloud, azure etc. so as to easily available to anyone and anywhere.

RESULT & ANALYSIS

In Data Augmentation how the distribution of intensities for the image pixel is displayed before augmentation is shown in below Fig2.
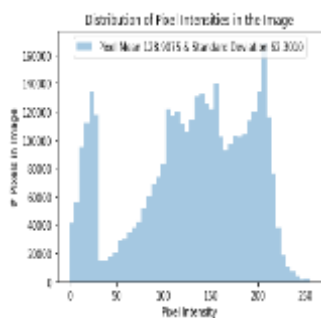

Fig:2

Before Data Augmentation pixel intensities

In Data Augmentation how the distribution of intensities for the image pixel is displayed after augmentation is shown in below Fig3.
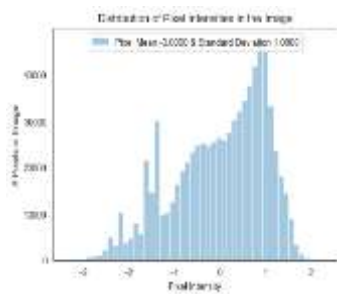

Fig:3

After Data Augmentation pixel intensities

Detail Information about the loss and accuracy of the CNN model is evaluated and displayed in Figure 4.
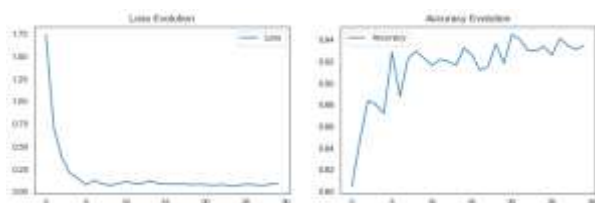

Fig:4

loss evolution & Accuracy evolution of CNN model

Detail Information about the loss and accuracy of the DenseNet model is evaluated and displayed in Figure 5.
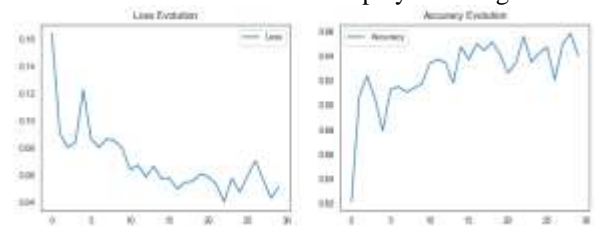

Fig:5

loss evolution & Accuracy evolution of Dense Net model

Detail Information about the loss and accuracy of the VGG16 model is evaluated and displayed in Figure 6.
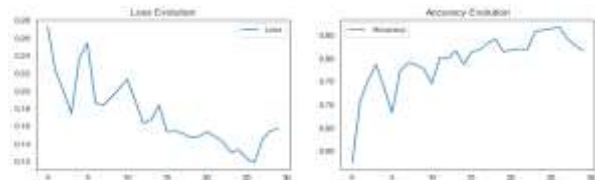

Fig:6

loss evolution & Accuracy evolution of VGG16 model

Detail Information about the loss and accuracy of the ResNet50 model is evaluated and displayed in Figure 7.
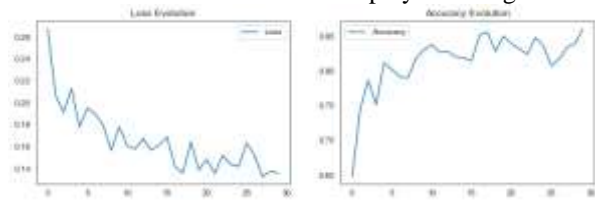

Fig:7

loss evolution & Accuracy evolution of ResNet50 model

Detail Information about the loss and accuracy of the Inception model is evaluated and displayed in Figure 8.
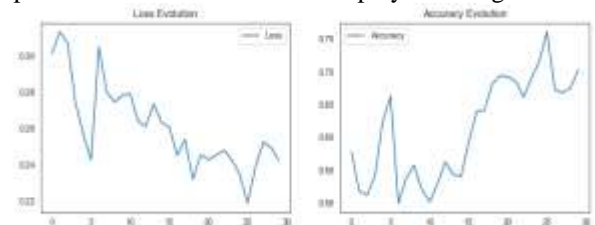

Fig:8

loss evolution & Accuracy evolution of Inception Net model

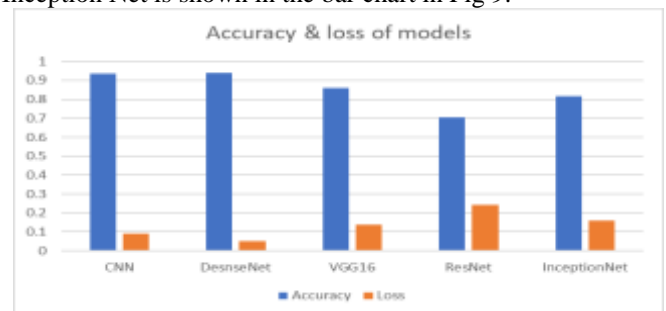Comparison of CNN, Dense Net, VGG16, ResNet50, and Inception Net is shown in the bar chart in Fig 9.

Fig:9

Comparison of models based on accuracy & loss

Summary of Result & Analysis: - Among 5 deep learning models Dense Net gives the best result so, it will be used to

deploy the model in the flask overall it produces 94% accuracy, and loss is 0.0509. Other 4 models like CNN give 93.05% accuracy and loss is 0.0907, VGG16 model produces 86.04% accuracy & 0.1358 loss, ResNet50 model produces 70.31% accuracy and loss 0.2423, Inception Net gives 81.76% accuracy and loss is 0.1577.

CONCLUSION

In this research CNN, Dense Net, VGG16, ResNet50, Inception Net models are tested with chest-Xray images and among all models, Dense Net gives 94.00% accuracy that is the highest. So Dense Net model is saved and loaded in a flask to deploy the model to run the web app. This web app will help more to radiologists reduce their work. This system is also useful for doctors to detect the disease easily& correctly as it produces 94% accurate results. This web app can be deployed on the cloud and can be run anywhere anytime. If we change the number of epochs and batch size, we can also increase the accuracy of the model again to get a more accurate result. In covid like pandemic situation number of patients are increased and expert radiologists and doctors are less in numbers that causing overburden to radiologists and doctors this computer-aided system that is a web app which is developed using flask and deep learning model could reduce the work by detecting the pneumonia disease automatically with the help of chest-Xray.

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