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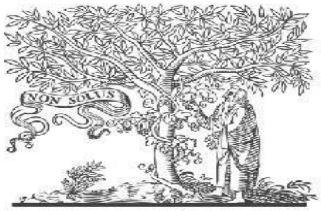

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Title **PNEUMONIA AFFECTED LUNG IDENTIFICATION USING DEEP LEARNING**

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PNEUMONIA AFFECTED LUNG IDENTIFICATION USING DEEP LEARNING

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Abstract

A deep learning model titled the Pneumonia Affected Lung Identification using Deep learning aims to correctly identify pneumonia in chest X-ray images. The model makes use of the VGG16 architecture, a well-known convolutional neural network that performs admirably on tasks involving picture classification.

Eight thousand of chest X-ray images with labels indicating the presence or absence of pneumonia along with the type of Pneumonia make up the dataset used for training and testing. The pre-trained VGG16 model was adjusted on the pneumonia dataset during the model's transfer learning training **[1]**.

The outcomes show that the model had a high level of success in diagnosing pneumonia from chest X-ray pictures. Precision, recall, and F1 score were just a few of the evaluation criteria that were used to assess the model's performance. The outcomes show that the model can identify pneumonia using high accuracy and has the potential to assist healthcare professionals in diagnosing the disease.

Overall, the Pneumonia Identification using VGG16**[7]** demonstrates the power of deep learning models in medical image analysis and highlights the potential of these models in improving disease diagnosis and treatment.

Keywords: VGG16, deep learning, transfer learning, accuracy, evaluation metrics, precision, recall, F1 score.

Introduction

Pneumonia is an infection that occurs in air sacs that are present in the lungs. It is the largest infectious disease which causes death in children worldwide. Pneumonia killed 7,40,180 children under the age of 5 in 2019, according to it accounts for 14% of all deaths of children under 5 years old. Symptoms of pneumonia include cough with pus, fever, chills, and difficulty breathing.

Pneumonia can be identified with the help of a chest x-ray. It is caused by viruses, bacteria, and fungi. It is difficult for a radiologist to identify pneumonia in a person.so, we propose a computer Aided pneumonia detection using an existing deep learning-based CNN architecture VGG16. In a chest x-ray we can identify the Pneumonia in a lung as a white spot.

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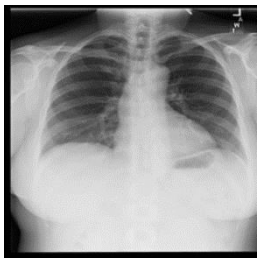

Figure1: shows the x-ray of normal lung image.

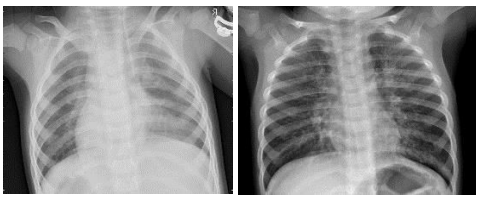

Figure 2: (left) bacterial pneumonia (right) viral pneumonia

A radiologist tries to identify the white spots present in the lungs which are very hard to find in a chest x-ray.

Literature Survey

In recent years, numerous and diverse types of work have been carried out in medical image processing. Researchers from various ground such as computer vision, image processing and machine learning came into a place in the field of Medical Image Processing. We have studied some of the existing papers to find the most useful and advanced methods that were used in the existing articles in recent times. we will discuss thoroughly these papers and their working procedures which are related to our work

(A)Pneumonia Detection Using Convolutional Neural Networks (CNNs):[6] (V. Sirish Kaushik, Anand Nayyar, Gaurav Kataria and Rachna Jain)

CNN model was built from the ground up and trained on the Kaggle Chest X-Ray Pictures (Pneumonia) dataset. The models have been implemented using the TensorFlow backend of the Kera's neural network toolkit. 5216 training photos, 624 test images, and 16 validation images make up the dataset. The dataset has undergone data augmentation to produce better results. For the training dataset, the four models were each trained with a different number of convolutional layers. With training batch sizes of 32 and testing batch sizes of 1, each model was trained for 20 epochs.

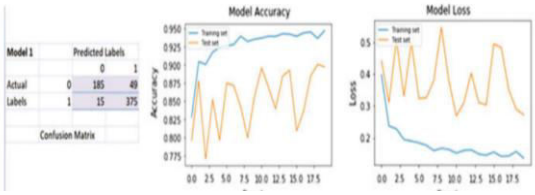

Figure 3: Confusion matrix and performance plots

To study the performance of each CNN classifier model, validation accuracy, recall and F1 score were evaluated as the performance measures. Accuracy and loss graphs were also studied. The confusion matrix was also computed for each model.

The accuracy of this model is calculated based on results of performance based on the formula

$$Accuracy = \frac{(actual\ postive + actual\ negative)}{(false\ positive + actual\ postive + false\ negative + actual\ negative)}$$

Based on the above formula the accuracyof this model is calculated to be 60%. But as we keep on increasing the convolution layers, we can achieve an accuracy of 80-90%. We can observe that

this model is model is over fitted as shown in the above figure3.

(B) Pneumonia Detection Using Deep Learning Based on Convolutional Neural Network:[2](Luka Racic, Tomo Popovic, Steven Cakic, Steven Sandi)

deep learning refers to a broad category of neural network architectures that have numerous hidden layers, whereas CNNs are a specific kind of neural network that are employed for image and video recognition. Although CNNs are one of the fundamental components of deep learning, deep learning employs other types of neural networks as well. A dataset of (1.16 GB) Size has been imported from Kaggle, with total of 5856 jpeg images split into 3 folders Test, Train and Val folders each again divided into category Pneumonia and Normal Images of chest X-ray.

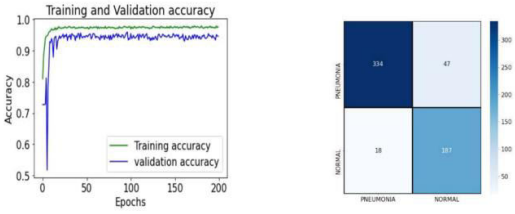

Fig 4: confusion matrix and performance plots

Based on the above figures the performance of this model is good and this model can achieve high accuracy but the dataset used foe this model is biased and leads to a greater number of false positives.

Problem Identification

Even though there is huge advancement of computer vision in the field of medicine we are still lacking in identifying Pneumonia with high accuracy. In this paper we propose a pretrained VGG16**[3]** model which helps to achieve high accuracy with a specified dataset which doesn't contain data imbalance.

Methodology and Implementations

The major steps involved in building our VVG16 model are collecting the dataset, Training our model with the dataset, and Modelling and Analysis of our model. Each step explained below

1.Collecting dataset

We used the chest x-ray dataset, but we saw there was an imbalance in the dataset. An imbalance in the dataset leads to less accurate results, so to avoid this imbalance we add some images from another dataset to make the results accurate. We took 2 different datasets, namely nih, covid19_radiogarphy **[1][4][5]**. The imbalance in a dataset is due to the presence of a greater number of pneumonia-affected lung images than that of normal lung images.

FOLDER	CATEGORY(NUMBER OF IMAGES) (Before)			FOLDER	CATEGORY(NUMBER OF IMAGES) (After)		
	Viral Pneumonia	Bacteria Pneumonia	NORMAL		Viral Pneumonia	Bacteria Pneumonia	NORMAL
TEST	148	242	234	TEST	148	242	234
TRAIN	1345	2530	1341	TRAIN	1345	2530	3979
VALIDATE	4	4	8	VALIDATE	4	4	8

Figure5: showing the number of images in the data set

1.Training our model with the dataset

We trained our model with the newly obtained dataset. For training our model, we just removed the top layer of a pre-

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trained VGG16 so that we can adjust the weights of our model to this new dataset.

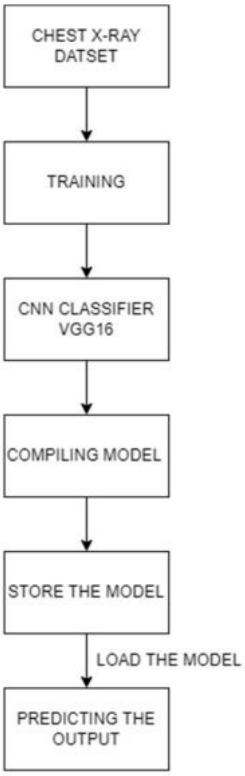

Figure 6: Work Flow

We stored our model in h5 format later we can load and classify a given x-ray image into any of the 3 classes mentioned above.

All the images used for training are of size (224*224*3) it is the default input size of VGG16.we used test data generator and train data generator methods present in keras library we used 50 epochs each of batch size 32, used SoftMax as activation function at the output layer since we are using multiclass classification, Adam optimizer is used to reduce the loss function.

2.Modelling and Analysis

We created our VGG16 model with our custom top layer now this top layer can be used to make predictions about whether a person is suffering from pneumonia or not. The below-given image shows the summary of our model.

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	[(None, 224, 224, 3)]	0
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590080
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590080
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 4096)	102764544
dense_1 (Dense)	(None, 4096)	16781312
dense_2 (Dense)	(None, 3)	12291

Total params: 134,272,835
Trainable params: 119,558,147
Non-trainable params: 14,714,688

Figure 7: summary of VGG16 model

Here the non-trainable parameters are used in VGG16 are used for transfer learning and regularization, which can help to improve the performance and stability of the model. trainable parameters in VGG16 are used for feature extraction, classification, and fine-tuning, which can help to improve the model's performance on a variety of computer vision tasks.

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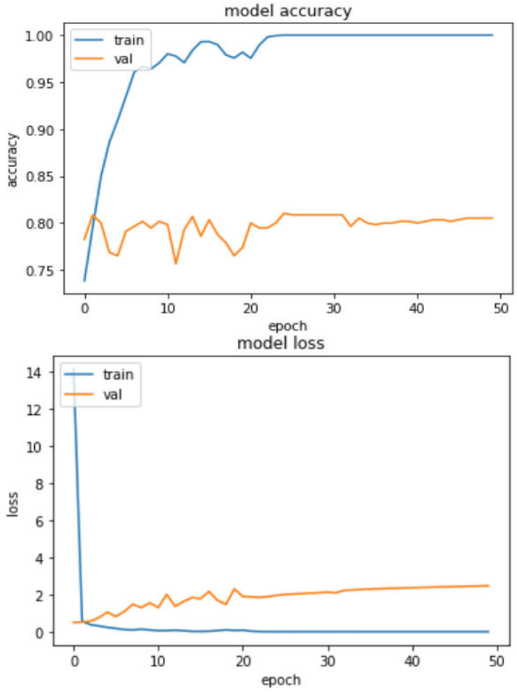

Figure 8: Plots obtained from our training model

From the model loss plot, we can conclude that

S.No	Class	Accuracy	Precision	Recall	F1 score
1	Normal	94%	99%	86%	92%
2	Bacteria Pneumonia	93%	86%	97%	91%
3	Viral Pneumonia	93%	86%	85%	85%

Table 1: results obtained from confusion matrix.

our model is slightly overfitting but performing well as the difference between training loss and validation loss is minimum. hence, we can consider our model as a good fitting model. From the model accuracy plot we can say that our model is performing well.

Results

After saving our model, we can make predictions with our model by using Keras library in python. We obtained a confusion matrix using our model with our test set. The image given below shows obtained confusion matrix with our model.

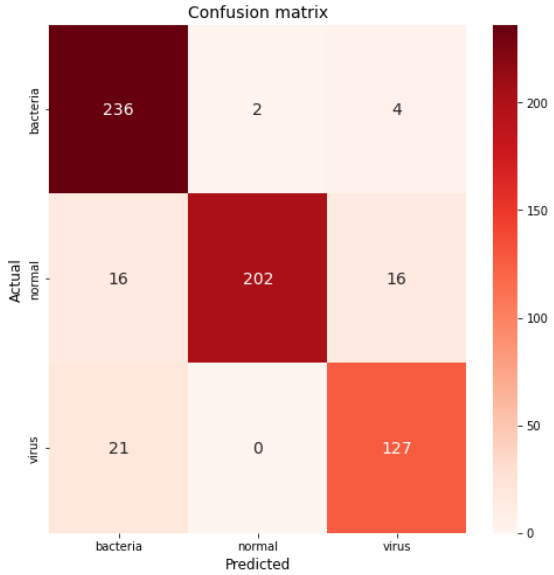

Figure 9: Confusion matrix.

From the above confusion matrix, we can obtain the accuracy, precision, recall, F1 score. The values are given below.

There are 3 possible scenarios out of which 2 are negative and 1 is positive. The negative scenarios are the person having pneumonia, in this we display the person's name (image name) along with their X-ray, the output for negative cases will be as shown in the below figure.

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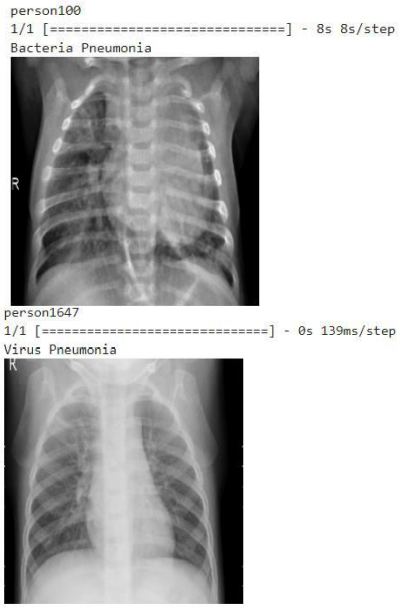

Figure 10: Output for negative case.

For positive case we just prompt normal along with person's name on the terminal as shown in the figure below.

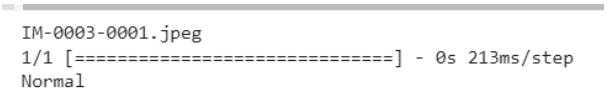

Figure 11: Output for the positive case.

Even though our model is slightly overfitting we can make it more reliable on adding some more images for training.

Conclusion

We created a VGG16 model which can predict if a person is suffering from Pneumonia or not and also adds if the person is suffering from viral Pneumonia or Bacterial Pneumonia, else the person is healthy, with a mean accuracy of 93%.

Limitations and Future Scope:

Our model is not completely reliable it is slightly over fitted model but we can improve its performance by adding a greater number of different types of images so that our model will try extract all the possible features. NIH is one of the best datasets for lungs and its diseases there are 7 different types of possible classifications. We can train our model with NIH dataset our model can identify 7 types of lung diseases.

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Detection Using Convolutional Neural Networks (CNNs)

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