PNEUMONIA X-RAY IMAGE DETECTION

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I.Definition

Project Overview

- Pneumonia is an acute infection of the lungs that produces coughing, fever, chills, muscles aches, and difficulty breathing in those who suffer from it.

- Pneumonic infection has been noted throughout human history, with mentions of the disease appearing during early Greek civilization. However, despite our long history with the disease, pneumonia remains a serious medical concern throughout the global community today, with millions of cases of pneumonia-related hospitalizations and deaths worldwide.

- Each year, over 1.5 million children die of pneumonia, mostly within developing nations.

Increasing our understanding of both the primary causative agent, *Streptococcus pneumonia*, and how we as a society have handled the management and treatment of pneumonia on a global scale may help us to increase access and efficiency of treatment options and to someday severely reduce detrimental affects of the disease.[1]

DATASETS AND INPUT:

- The dataset is organized into 3 folders (train, test, val) and contains subfolders for each image category (Pneumonia/Normal). There are 5,863 X-Ray images (JPEG) and 2 categories (Pneumonia/Normal).[2]
- Chest X-ray images (anterior-posterior) were selected from retrospective cohorts of pediatric patients of one to five years old from Guangzhou Women and Children's Medical Center, Guangzhou. All chest X-ray imaging was performed as part of patients' routine clinical care.

For the analysis of chest x-ray images, all chest radiographs were initially screened for quality control by removing all low quality or unreadable scans. The diagnoses for the images were then graded by two expert physicians before being cleared for training the AI system. In order to account for any grading errors, the evaluation set was also checked by a third expert

Problem Statement:

The Aim of this project is to Detect the Pneumonia by using the X-Ray Images Dataset. In this project I am going to use Keras by adding Convolution Layers.

- My solution for identifying the pneumonia effected X-Ray Images is to add two Convolution Layers with activation function as 'relu' and two maxpooling layers with window size as (2,2)

Metrics

- Since this is a Classification problem ,For this project I used Accuracy as a Metrics in order to calculate the performance of the model and loss metric as 'binary_crossentropy'

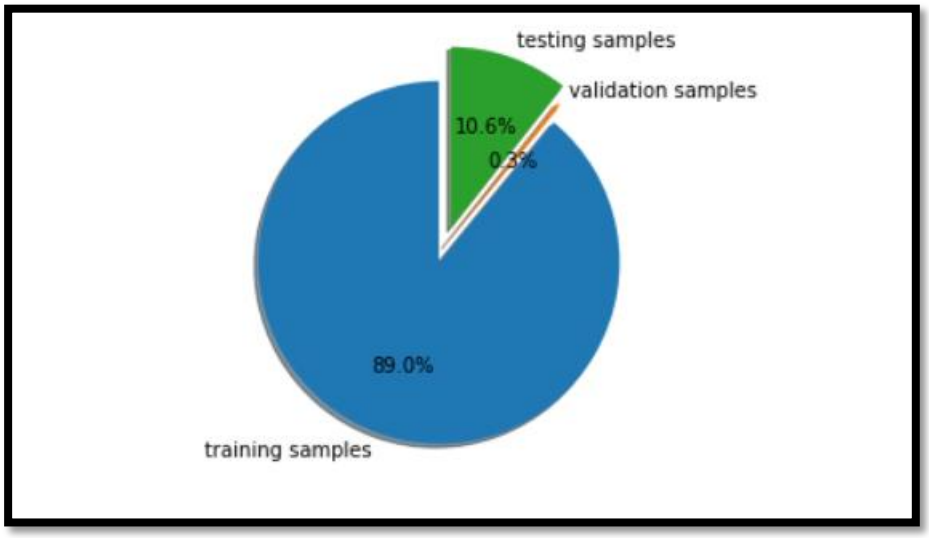
II.Analysis

Data Exploration

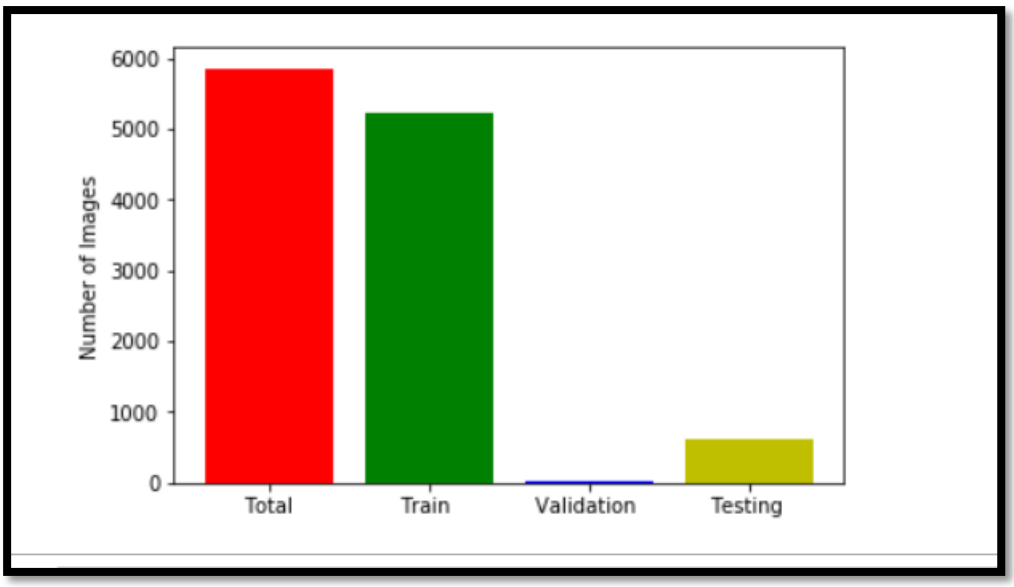
- The dataset is organized into 3 folders (train, test, val) and contains subfolders for each image category (Pneumonia/Normal). There are 5,863 X-Ray images (JPEG) and 2 categories (Pneumonia/Normal).[2]

Exploratory Visualization

- In this Dataset, There are 5218 training images, only 18 images as validation and 624 images as testing in total of 5860 X –Ray Images
- Pie chart will be

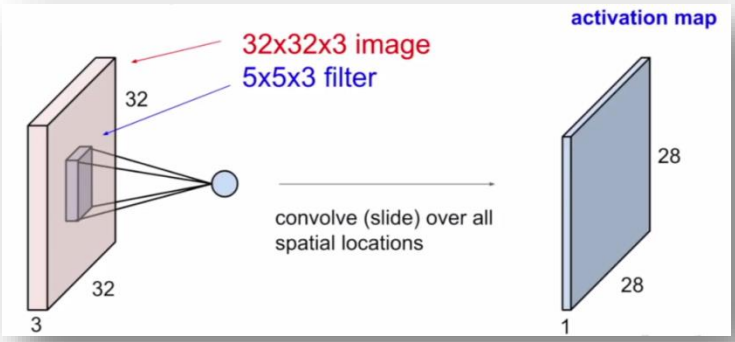


- The Bar plot looks like



Algorithms and Techniques

- In this project to solve the problem ,I used convolution network as a technique (i.e),adding convolution Layers which consists of input layer, hidden layer and output layer.I added the Convolution Layer at first so I mentioned the input shape as (64,64,3) .The Convolution Layer is represented as



- The activation function used is ‘relu’ which is defined as positive part of the argument, Since we are dealing with images this activation function should be used because the pixel values always lies within the positive range
- The two max pooling layers are used in order to reduce the dimension more specifically defined as dimensionality reduction. The Pooling window size I considered is 2*2 matrix.
- At last the Dense layer is added with one node and with sigmoid function as activation function.

Benchmark

- The Benchmark model I considered is one convolution Layer with one maxpooling layer and also 10 number of epochs which gives me testing accuracy as 62.5%.
- In order to beat the accuracy of Benchmark model ,I added one more Convolution layer and Maxpooling Layer with same number of epochs as 10
- Successfully I increased the accuracy to 85.6% which can be considered as best model to evaluate

III.Methodology

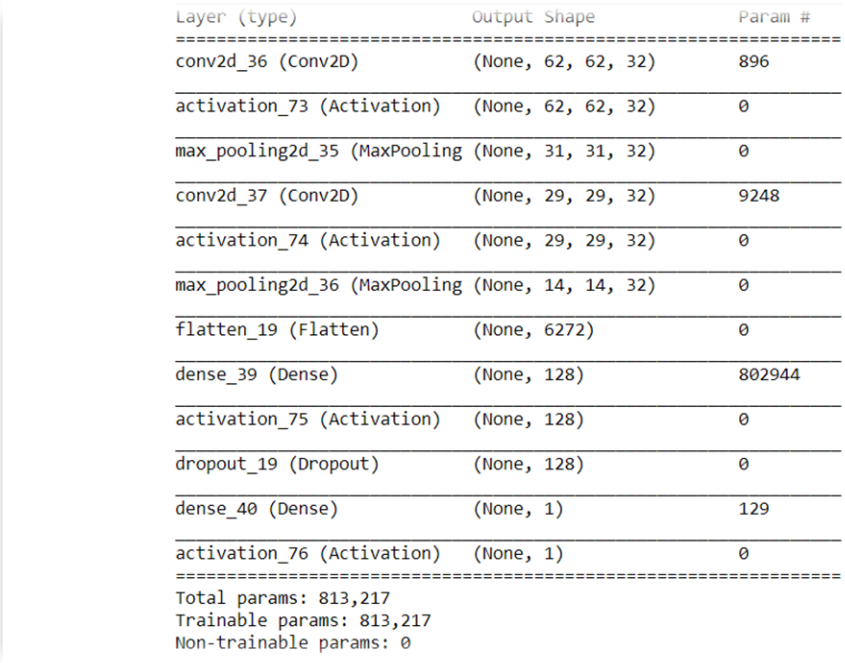
Data Preprocessing

- In case of Image Processing ,it is very important to perform the data augmentation .I have performed augmentation by using ImageDataGenerator() method which will rescales the images and flips images horizontally
- This process will play major role because there will be chance of images where the size can be different and images represented in horizontal direction, so data augmentation will helps to evaluate the model even the images are not organised
- The Images height and width for model is considered as 64,64 and with 3 channels, so that every Image will have same dimensions

Implementation

As an implementation,two convolution layers are used with two maxooling layers and activation function as ‘relu’. Dropouts are also added to avoid the overfitting .The

Architecture is



Layer (type)	Output Shape	Param #
conv2d_36 (Conv2D)	(None, 62, 62, 32)	896
activation_73 (Activation)	(None, 62, 62, 32)	0
max_pooling2d_35 (MaxPooling	(None, 31, 31, 32)	0
conv2d_37 (Conv2D)	(None, 29, 29, 32)	9248
activation_74 (Activation)	(None, 29, 29, 32)	0
max_pooling2d_36 (MaxPooling	(None, 14, 14, 32)	0
flatten_19 (Flatten)	(None, 6272)	0
dense_39 (Dense)	(None, 128)	802944
activation_75 (Activation)	(None, 128)	0
dropout_19 (Dropout)	(None, 128)	0
dense_40 (Dense)	(None, 1)	129
activation_76 (Activation)	(None, 1)	0

Total params: 813,217
Trainable params: 813,217
Non-trainable params: 0

Refinement

- At first model gets an accuracy of 62.5%,so to improve the accuracy I have changed few parameters such optimizer to ‘adam’ while compiling ,before that the model has ‘rmsprop’ optimizer
- While fitting the data, I have changed steps per epoch to 163 from 326 because in first model the steps per epoch 326 is taking much more time and also gave an low accuracy ,so i considered half of the stepsperepoch from previous model which gives me more accuracy

IV.Results

Model Evaluation and Validation

- In Final model, the accuracy of training samples have nearly 90% accuracy while for validation it is reduced to 60 %,this is due to there are less number of validation images in given dataset .Any ways the testing accuracy is 85% which can be noted as good model for performance
- Consider the Loss for training and testing where testing images has low loss that means it is performing good predictions at testing

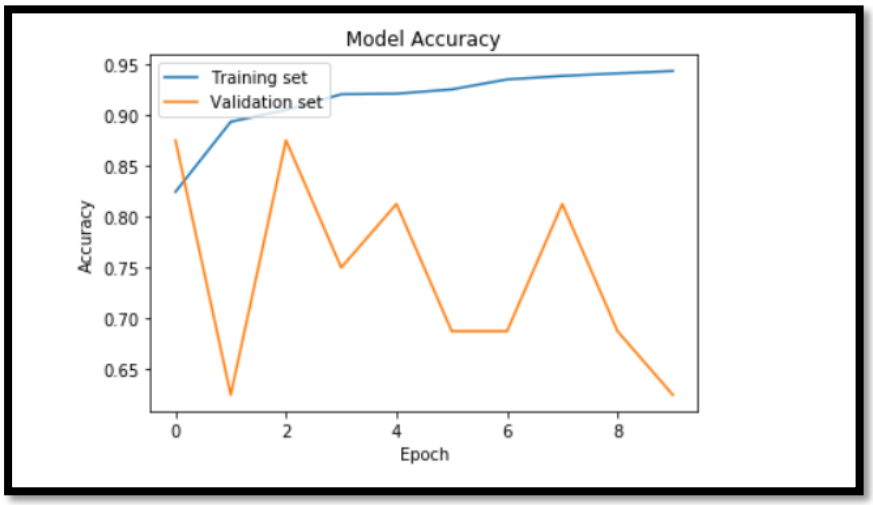
Justification

The final results occurred from the model found stronger than the benchmark model reported earlier in terms of improving the accuracy and model implementation time .For benchmark model it takes lot of time while fitting the data after optimizing the parameters final model did not take as much of time to evaluate. So I consider 2nd model as best model for detecting Pneumonia effected X-Ray Images

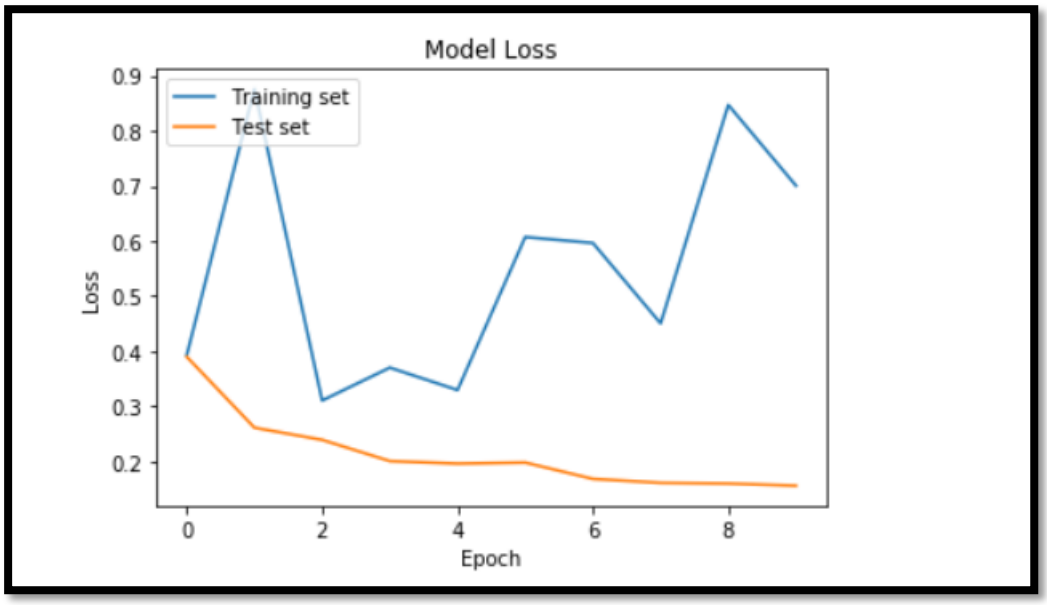
V.Conclusion

Free-Form Visualization

- Accuracy Results



- Loss results



Reflection

1) First I have gone through some of the problems in Kaggle, but this pneumonia detection seems to be very interesting and thought this can be helpful for society or in medical field
2) Next I gained knowledge about the pneumonia and how it is effected and what type of lungs will look like if any one have pneumonia .
3) Afterwards I started downloading dataset and plots the X-Ray images in python by using matplotlib and with help of keras.
4) As I mentioned ,Dataset contains the three directories train, val, test and each of it contains normal and pneumonia effected Images
5) Then, I thought to use Deep Learning approach to implement this model ,so I used Convolution Neural Network by using Keras
6) Starting I added convolution Layer and maxpooling layer and also some dense layers to create any benchmark model
7) This benchmark model gives the accuracy of 62% which can be considered as least score for model
8) Then, I want to add another Convolution layer and Maxpooling Layer and also changed the optimizer from 'rmsprop' to 'adam' in order to increase the accuracy .
9) By considering some of the factors like time and efficient the second model seems to be more effective than Benchmark Model because this model gives accuracy as 85%
10) Finally I conlude that this model can be implemented in real time by creating any web applications or other software applications since it can predict the pneumonia effected X-Ray images very well
11) From all of the above steps ,I felt more difficult at parameter tuning to get good optimized model.

Improvement

In order to improve my model performance , Transfer Learning technique can be more effective .I think GridSearch mechanism can also be applied here for improvement in case of parameter tuning. At Last adding more number of images in validation dataset can give better results for it .

References:

[1] : https://www.news-medical.net/health/Pneumonia-History.aspx

[2]: https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia