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Viral vs. Bacterial Pneumonia Image Classification using Transfer Learning

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ABSTRACT

The Purpose of this Project is to Develop a Project to Detect Covid-19 Viral and Bacterial Pneumonia using Transfer Learning form medical images. Covid 19 2nd wave is spreading Rapidly and more deadly than the first wave we need effective and accurate models to Detect Covid-19 using AI and the challenges are quite big we don't have that big dataset so instead of building model from scratch we used prebuild CNN Model and Transfer Learning for accurate prediction on test Dataset. This one is just Binary Classification model which uses images Bacterial and viral pneumonia images for the training

Keywords— *Tensorflow, Keras, Deep Learning, Transfer Learning, covid-19*

1. INTRODUCTION

A number of mysterious cases of viral pneumonia were detected in December 2019 China's city Wuhan, which then spread to the rest of the countries across globe. some cases were reported in the countries like Germany, France and Italy Then it started spreading across the globe. As of 1 June 2021, 30.7L people died of COVID-19, while 17.3CR cases in 210 countries were reported the significant spread of the pandemic around the all countries has meant that the number of Medical Devices available for doctors and health workers fighting the disease is not sufficient. the time required for Covid-19 diagnosis and the costs of the laboratory kits used for diagnosis, artificial intelligence research and applications have been initiated to support doctors and Health workers who trying to treat patients . COVID 19 tests are expected to be used in clinical settings but now in this worst scenario for COVID-19 test results takes more than 48 hours and not all countries will get access to those Rapid test kits that give results rapidly and Accurate. AI techniques have produced stable and accurate results in the applications that use image classification. Deep Learning algorithm CNN which takes its name from the number of its hidden layers now gained a special place in the field of AI by providing successful results for both image-based classification applications and regression problems in past 8-10 years. So, we decided to build a images classification model using transfer learning to detect whether its bacterial or viral pneumonia Transfer learning can be useful in those applications of CNN where the dataset is not large. Transfer learning utilizes trained models from large datasets such as ImageNet which can be used for another application with a comparatively smaller dataset.

2. METHODOLOGY

2.1 Dataset

The dataset obtained from Kaggle repository and GitHub which contains Chest X-Ray scans of covid and Bacterial pneumonia. we used This collected dataset is not meant to claim the diagnostic and testing ability of our Deep Learning model but to research about various ways of efficiently detecting Covid-19 infections using images classification techniques. The collected dataset consists of 5000 total chest X-ray images. This data set is divided into training and testing set of covid and bacterial pneumonia. In this training set 2300 are covid, and 3600 is pneumonia so just to make our model balanced we made it 2300 for covid and 2300 pneumonia.
https://github.com/ieee8023/covid-chestxray-dataset

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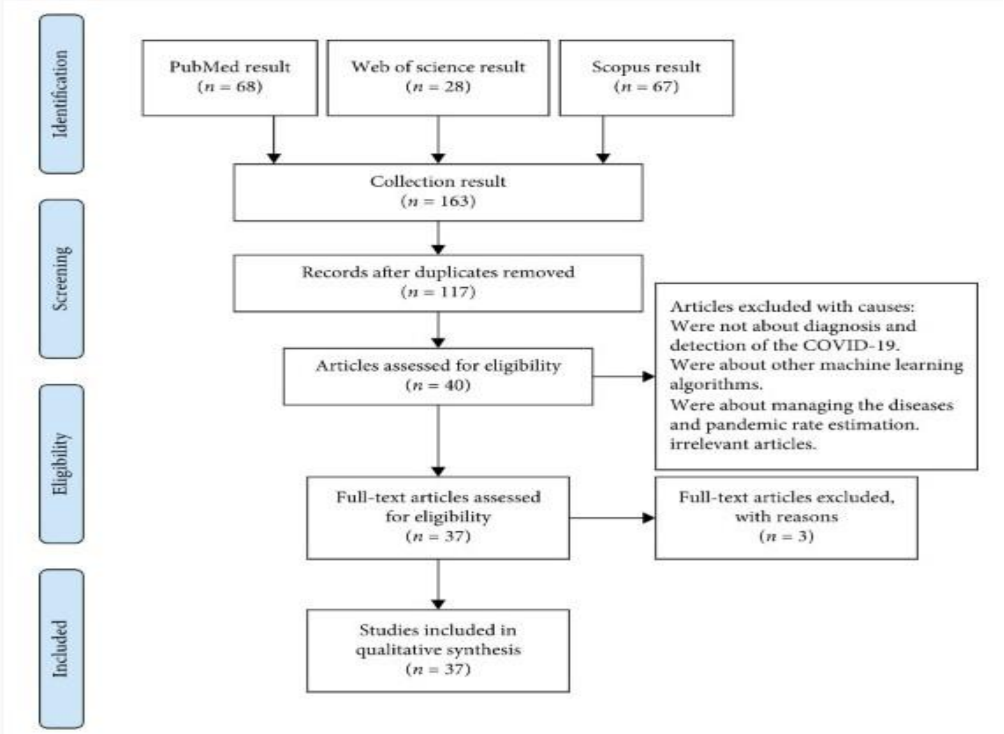
2.2 Data Extraction

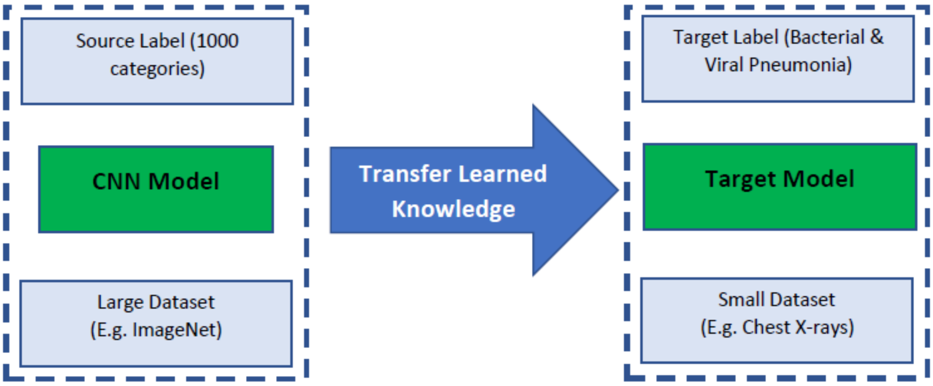
Relevant details of their methodologies, and results are recorded in data extraction forms. Data selection , extraction was performed based on fig A. To identify DL and Algo methods main details of the methods and their results are recorded in data extraction sheets given below. some researchers extracted the data then differences between both studies were resolved using discussion



3. MODELING AND ANALYSIS

3.1 Transfer Learning Experiments

The model used is a 121-layer Dense Convolutional Network DenseNet trained on the ImageNet dataset. Use the pre-trained DenseNet121 model and add a Pooling layer, dropout layerand finally, a dense layer with Sigmoid activation for making the predictions.



Layers	Output Size	DenseNet-121	DenseNet-169	DenseNet-201	DenseNet-264
Convolution	112 × 112	7 × 7 conv, stride 2			
Pooling	56 × 56	3 × 3 max pool, stride 2			
Dense Block (1)	56 × 56	[1 × 1 conv, 3 × 3 conv] × 6	[1 × 1 conv, 3 × 3 conv] × 6	[1 × 1 conv, 3 × 3 conv] × 6	[1 × 1 conv, 3 × 3 conv] × 6
Transition Layer (1)	56 × 56	1 × 1 conv			
	28 × 28	2 × 2 average pool, stride 2			
Dense Block (2)	28 × 28	[1 × 1 conv, 3 × 3 conv] × 12	[1 × 1 conv, 3 × 3 conv] × 12	[1 × 1 conv, 3 × 3 conv] × 12	[1 × 1 conv, 3 × 3 conv] × 12
Transition Layer (2)	28 × 28	1 × 1 conv			
	14 × 14	2 × 2 average pool, stride 2			
Dense Block (3)	14 × 14	[1 × 1 conv, 3 × 3 conv] × 24	[1 × 1 conv, 3 × 3 conv] × 32	[1 × 1 conv, 3 × 3 conv] × 48	[1 × 1 conv, 3 × 3 conv] × 64
Transition Layer (3)	14 × 14	1 × 1 conv			
	7 × 7	2 × 2 average pool, stride 2			
Dense Block (4)	7 × 7	[1 × 1 conv, 3 × 3 conv] × 16	[1 × 1 conv, 3 × 3 conv] × 32	[1 × 1 conv, 3 × 3 conv] × 32	[1 × 1 conv, 3 × 3 conv] × 48
Classification Layer	1 × 1	7 × 7 global average pool			
		1000D fully-connected, softmax			

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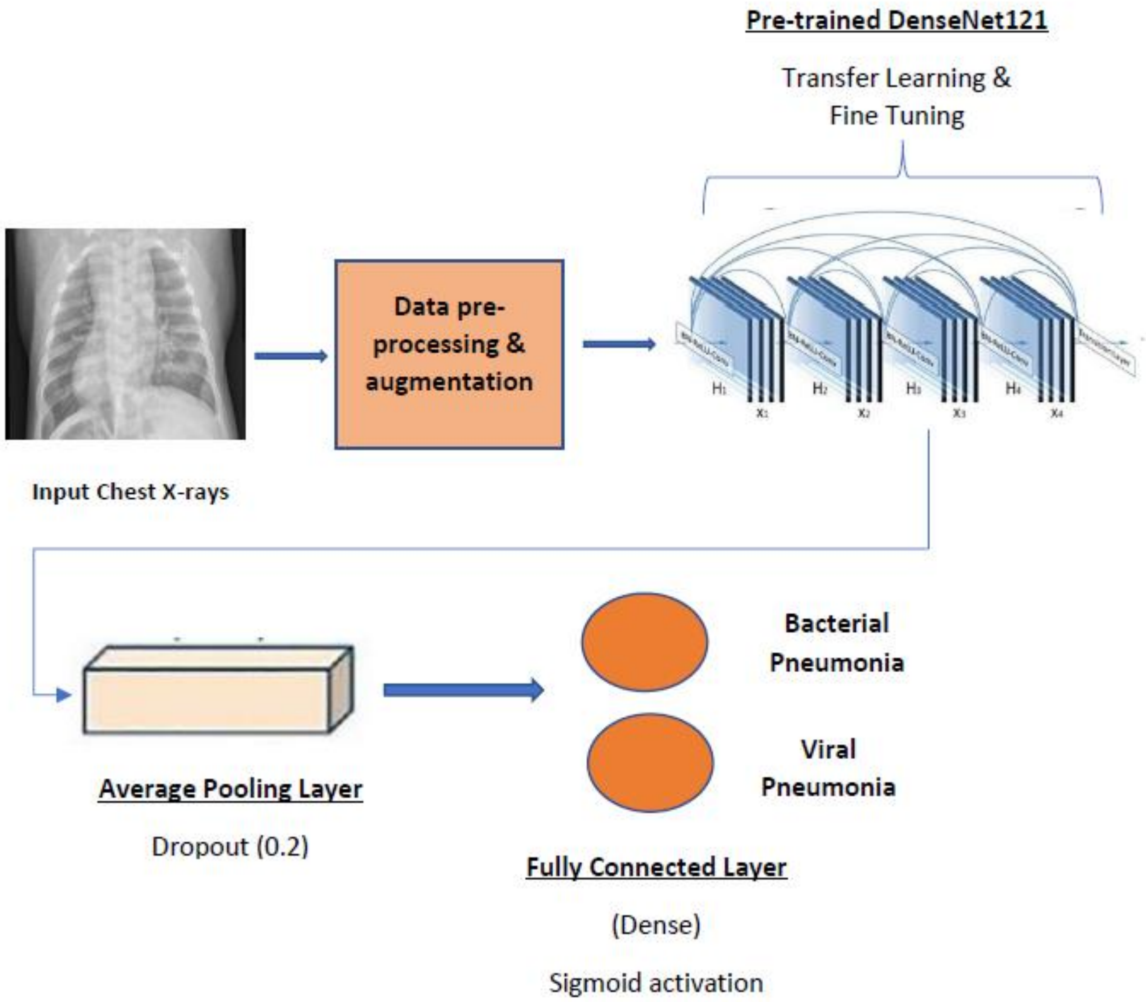

Optimizer

We tend to use Adam optimizer and that we initialise the learning a rate with 0.001 that is utilized in varied transfer learning approach

Loss

We tend to use binary cross-entropy since it's a binary classification task.

ReduceLRonPlateau cut back learning rate once a metric has stopped up. Models typically like reducing the training rate once learning stagnates. This request monitors a amount and if no improvement is seen for a 'patience' variety of epochs, the training rate is reduced. The parameter settings used square measure as follows:

- monitor: ‘val_loss’ (Validation loss)
- factor: zero.1 • patience: one
- verbose: one EarlyStopping: Stop coaching once a monitored metric has stopped up. presumptuous the goal of a coaching is to attenuate the loss. With this, the metric to be monitored would be 'loss', and mode would be 'min'. Once it's found not decreasing, the coaching terminates. Refer The parameter settings used square measure as follows: monitor: ‘val_loss’
- min_delta: zero.0001
- patience: a pair of
- verbose: one
- mode: ‘min’ ModelCheckpoint: request to save lots of the Keras model or model weights at some frequency. it's utilized in conjunction with coaching mistreatment model.fit() to save lots of a model or weights (in a stop file) at some interval, that the model or weights is loaded later to continue the coaching from the state saved.

The parameter settings used square measure as follows:

- filepath: the trail and file name to save lots of
- monitor: ‘val_loss’
- verbose: one • save_best_only: True
- save_weights_only: True We initial train the top-ranking classifier with the pre-trained model set to non-trainable. If you add a haphazardly initialized classifier on prime of a pre-trained model and conceive to train all layers collectively, the magnitude of the gradient updates are going to be large (due to the random weights from the classifier) and your pre-trained model can forget what it's learned. We save the simplest model within the method supported validation loss. The learning rate is reduced by an element of ten once the validation loss doesn't improve for AN epoch.

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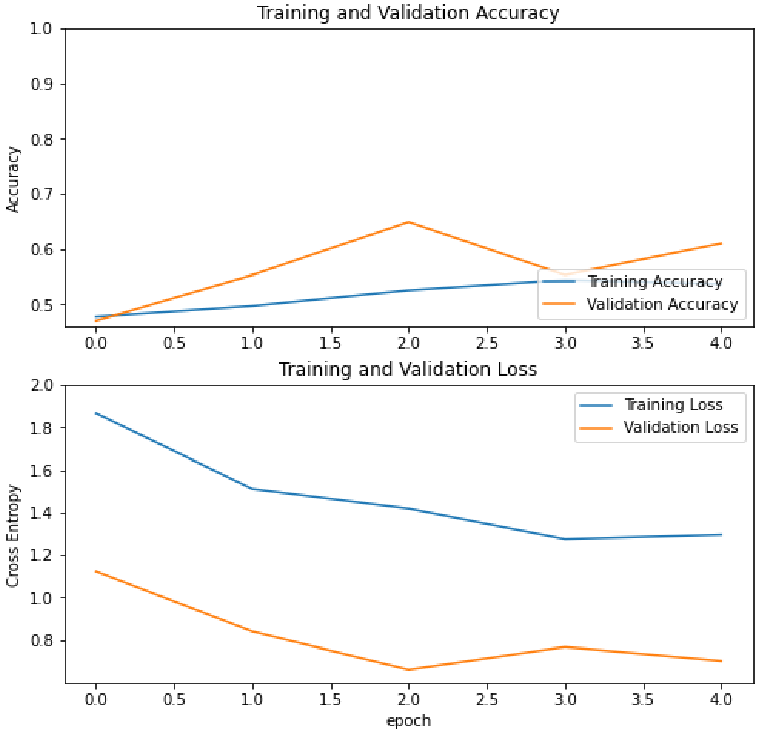
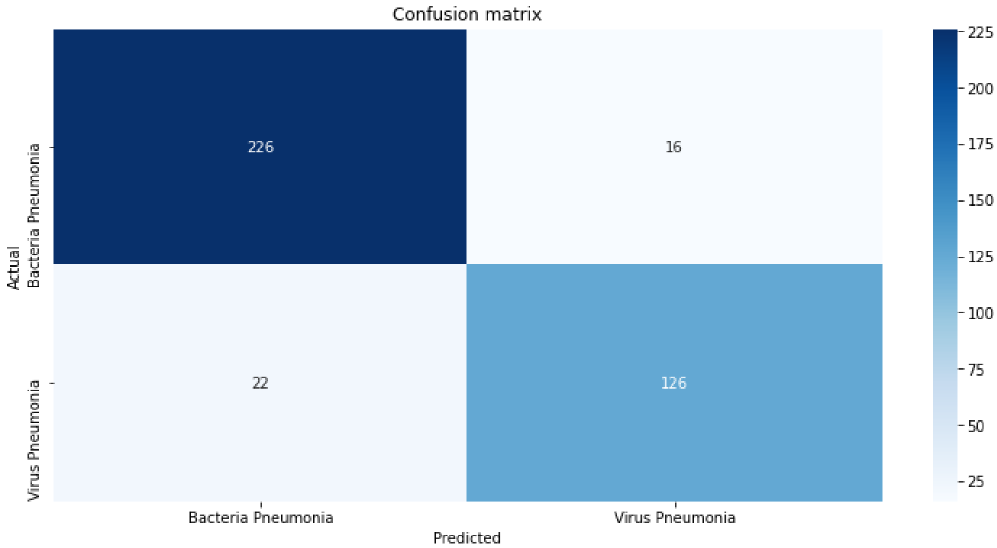


In most CNN networks, the higher up a layer is now the more specialized. The first few layers learn very simple , generic features that used almost all types of images if you go higher the features will be increasingly more specific to the dataset on which the CNN model was trained. TheMain goal of finetuning is to adapt these new features to give accurate result with the new dataset,



Model Interpretability using Grad-CAM

To help deep learning researcher debug their networks, Selvaraju et al.published a paper Grad-CAM Visual Explanations from Deep Networks via Gradient-based Localization

This method is:

- Easily implemented
- Works with nearly any Convolutional Neural Network architecture
- Can be used to visually debug where a network is looking in an image

Gradient-weighted Class Activation Mapping (Grad-CAM) works by finding the final convolutional layer in the network and then examining the gradient information flowing into that layer.

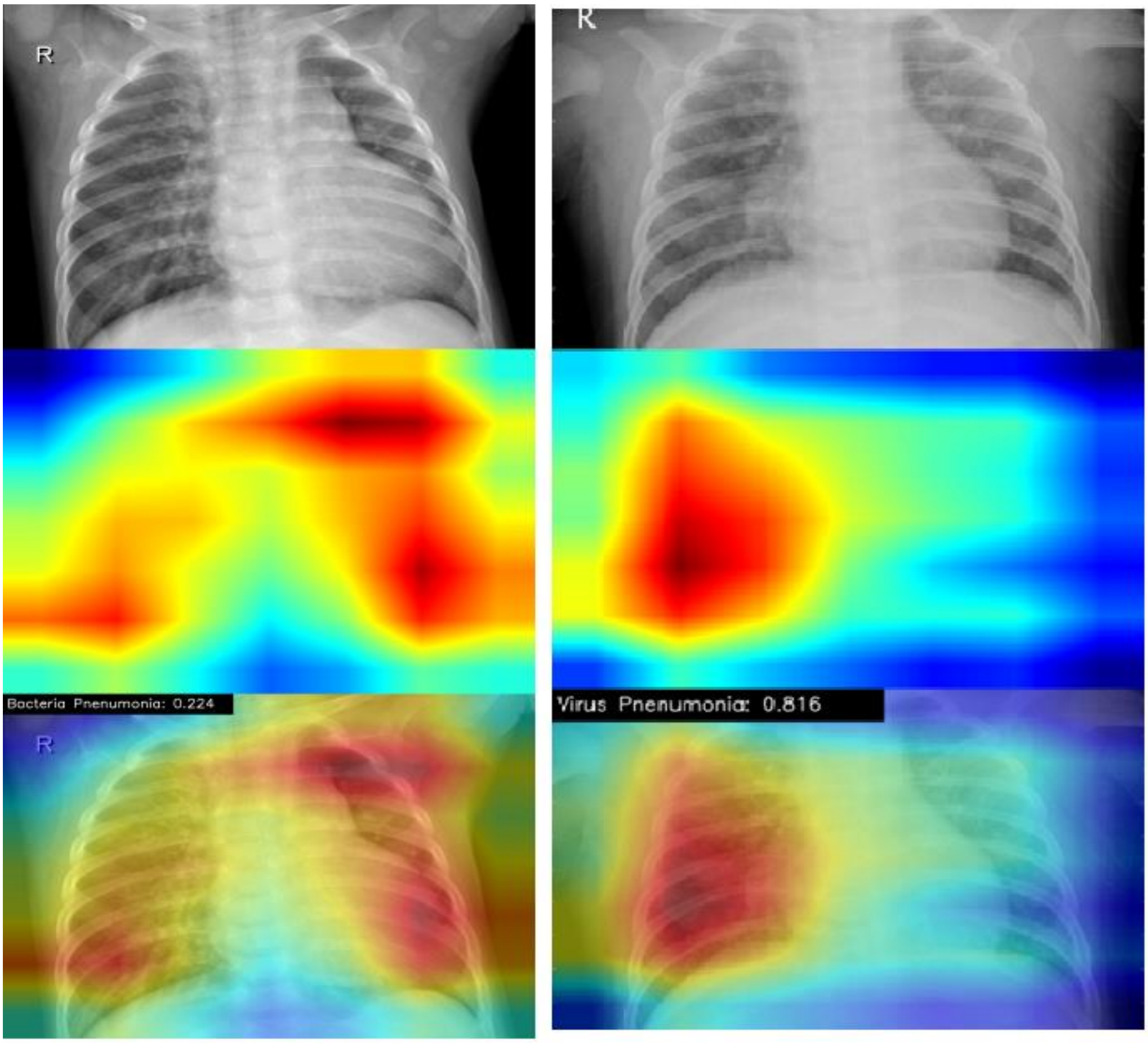
The output of Grad-CAM is a heatmap visualization for a given class label (either the top, predicted label or an arbitrary label we select for debugging). We can use this heatmap to visually verify where in the image the CNN is looking.

4. RESULTS AND DISCUSSION

fn_gradcam takes an image as an input and computes the GradCAM using the trained model. It finally prints three images stacked vertically.

1. Original image

2. Heatmap generated using the last convulational layer activations
3. Heatmap superimposed on the image (The predicted image class and probability is also included)



5. CONCLUSION

Covid-19 pandemic may be a growing manifold daily in entire world. each country has done subsume sizable amount of deaths and this is often perturbing therefore we'd like fast detection of Covid-19 therefore unfold of this virus may be reduced it might will facilitate medical examiner to scale back their burden, AI will play a giant role during this pandemic by distinguishing Corona virus infected patient. we experimented with multiple CNN Prebuild models in an attempt to classify the Covid-19 and traditional patients using their chest X-ray scans pictures . then we concluded that out of those 3 models, Darcovid and the XCeption internet has the most effective performance and this will be used for project. we've with success classified covid-19 and virus infection scans, and it helps the possible scope of applying such AI techniques within the future to automatize diagnosing and Detection tasks. The high accuracy obtained could also be a explanation for concern since it may be a results of overfitting therefore we have a tendency to used heat maps. This can be verified by testing it against new information that is made publicly accessible on github and kaggel, the large dataset for chest X-rays of positive and negative may be considered to validate our projected model on that. It is also prompt to consult any medical professionals for any sensible use case of this project. we have a tendency to as team don't intend to develop an ideal detection resolution however solely research concerning attainable economically possible ways that to help to discover this sickness. Such strategies could also be pursued for forthcoming analysis to prove their world implementation.

6. ACKNOWLEDGEMENTS

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