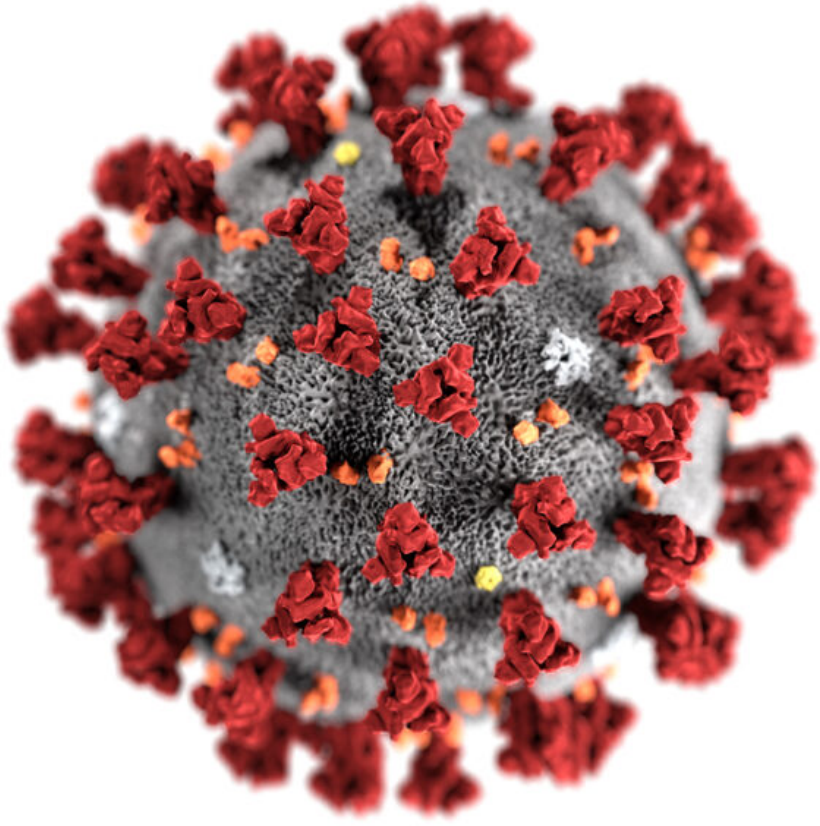

Detection and Localization of COVID-19 using Chest Radiographs (CXR)

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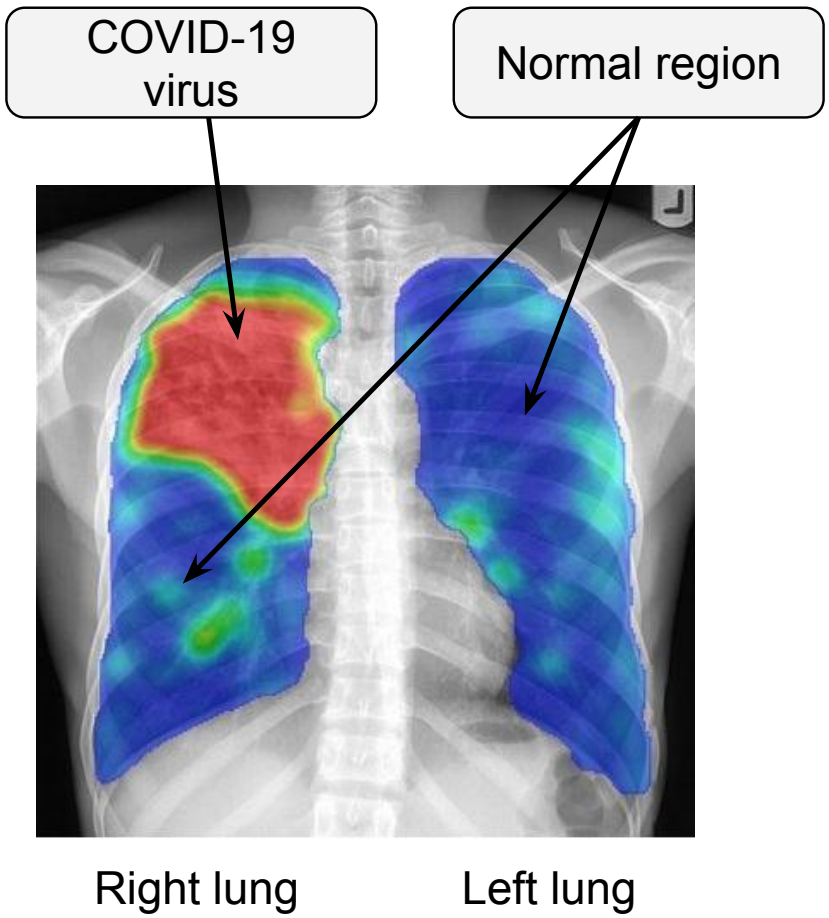
Overview

Introduction - Scope

- COVID-19 - severe acute respiratory disease caused by SARS-CoV-2 virus
- Detection of virus is important to control its spread
- Localization is necessary to monitor the spread of virus and to take precautions accordingly
- Mobile application for lay audience
- Percentage of damage done to the lungs
- Prediction of duration of hospitalization (if needed)
- Field of study: Medical Imaging, Machine Learning



Motivation

- Risk Stratification (Critical or Non-Critical)
- Aid in rapid screening
- Patient management - self-isolation or hospitalization
- Personalized care planning
- Complementary tool for medical specialists/radiologists to analyze the X-ray images
- X-ray is an inexpensive option for COVID detection as compared to PCR Test but not an alternative - PCR is the gold standard for COVID detection

Literature Review I

Method [1]	Results	Limitations
1. First time application [1] of ML algorithms (15 deep CNN visual extractors + 6 ML Classifiers) 2. No extensive data preprocessing or augmentation 3. End-to-end web-based detection system	1. Accuracy of 99% (MobileNet and InceptionV3) 2. Precision, recall and f1-score of 98% (DenseNet121)	1. Model is trained on limited dataset and is not tested on independent dataset 2. Detection System not validated by medical specialists/radiologists 3. Possibility of presense of viral or bacterial pneumomonia not taken into consideration

[1] S. H. Kassania, P. H. Kassanib, M. J. Wesolowskic, K. A. Schneidera,and R. Detersa, "Automatic detection of coronavirus disease (covid-19) in x-ray and ct images: A machine learning based approach," Biocybernetics and Biomedical Engineering, vol. 41, no. 3, pp.867–879, 202

Literature Review II

Method [2]	Results	Limitations
1. Used VGG16, ResNet50 and EfficientNetB0[2] 2. Trained a Generative Adversarial framework (CycleGAN) to generate synthetic COVID positive images	1. Accuracy of 93% with VGG16 2. Accuracy over 93% with synthetic images (VGG16) 3. Over 90% recall, 93% precision	1. Model trained on limited dataset 2. Shape deformations in some synthetic COVID +ve images 3. Model is not tested on independent dataset

[2]T. Zebin and S. Rezvy, "Covid-19 detection and disease progression visualization: Deep learning on chest x-rays for classification and coarse localization," Applied Intelligence, vol. 51, no. 2, pp. 1010–1021, 2021.

Literature Review III

Method [3]	**Results**	**Limitations**
1. Used VGG16[3] and ResNet50	1. Overall accuracy of 89.2%	1. Model trained on limited dataset
2. Performed 10-fold cross validation	2. Specificity of 99%	2. Lack of information on what stage of disease CXR is from and lack of information on outcomes
3. Augmentation to enhance dataset	3. Correctly identified COVID +ve cases 80.39%	3. Reduced resolution of images and no pixel intensification or pre-processing done to cope with irregular opacity shapes

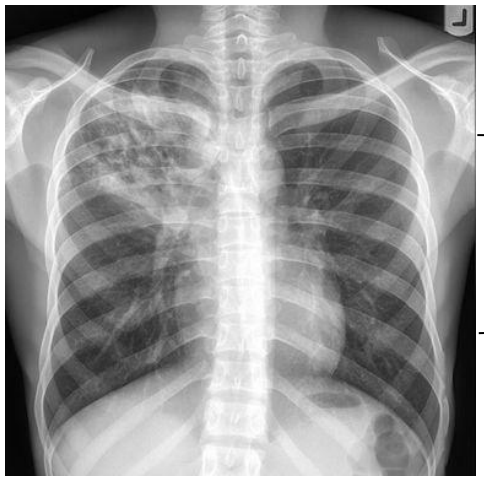
[3] L. O. Hall, R. Paul, D. B. Goldgof, and G. M. Goldgof, "Finding covid-19 from chest x-rays using deep learning on a small dataset," arXiv preprint arXiv:2004.02060,2020.

Problem Statement

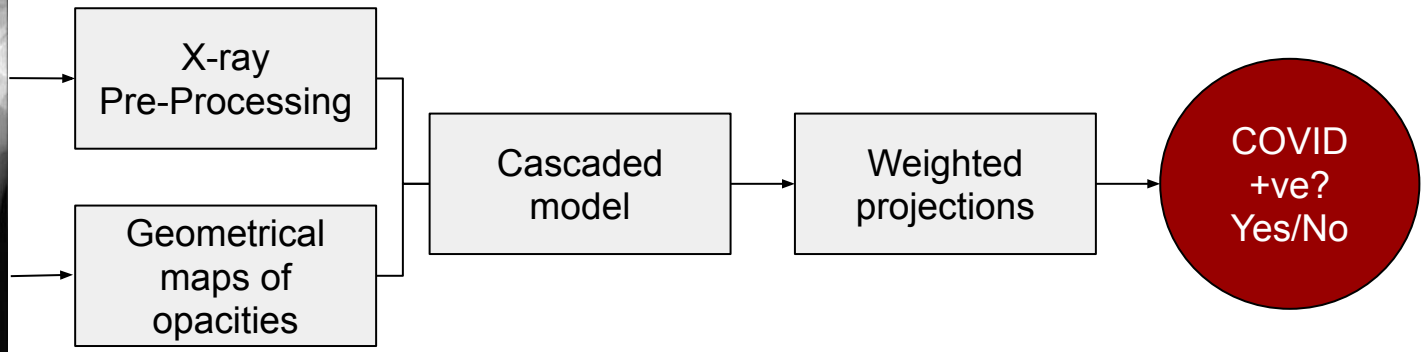
The COVID-19 disease is affecting millions of people worldwide and it has been seen that lungs are affected the most. The presence of multiple disease signatures in lungs, hazy lung opacities, irregular opacity shapes makes the COVID-19 detection and localization a daunting task. This project shall address the above problems by designing and implementing a robust solution utilizing the chest radiographs.

Proposed Methodology

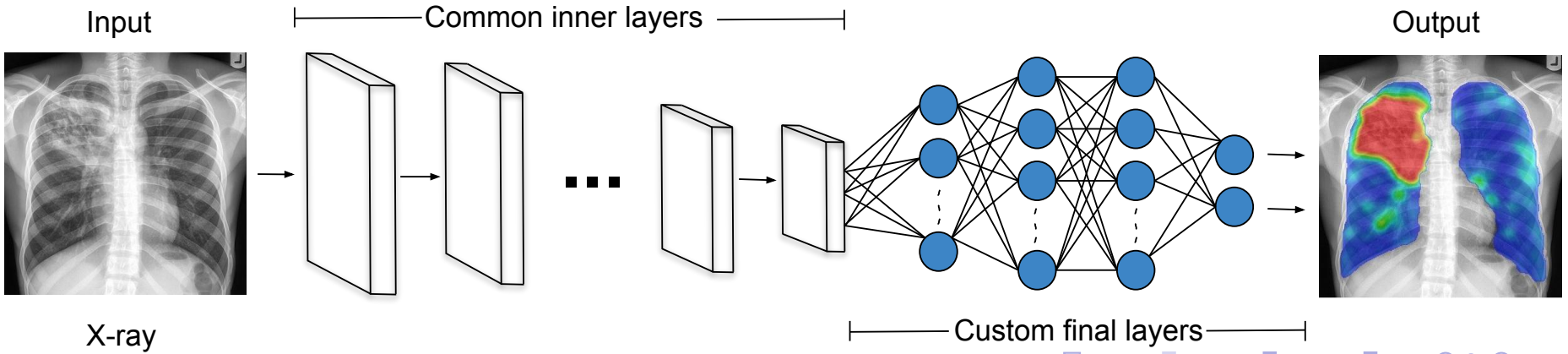
Model for Detection



X-Ray



Transfer Learning model for Localization



Objectives

1. To develop a mobile application that will help doctors, radiologists and other potential stakeholders in the early detection of COVID-19 abnormalities.

2. To assist doctors in the progression monitoring of COVID-19 disease by accurately localizing its parts in a chest radiograph.

3. To calculate the percentage of damage done to the lungs and the duration of hospitalization (if required).

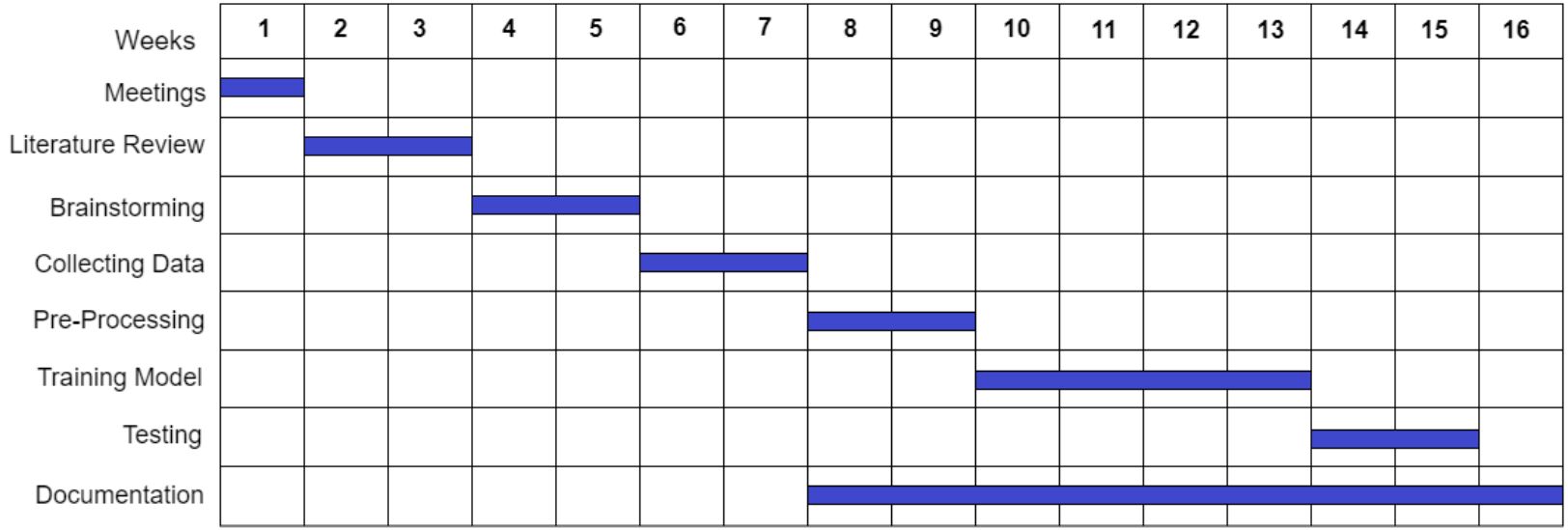
Expected Results

FYP-I:
A trained model for the detection of COVID-19 with high accuracy.

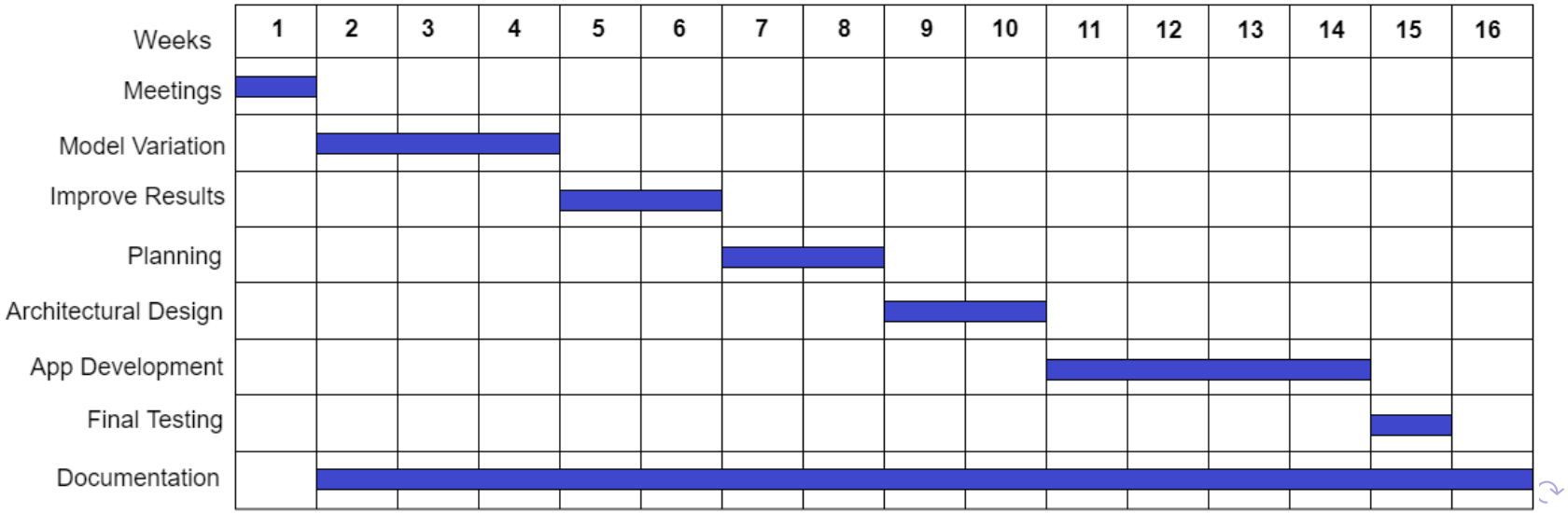
FYP-II:
Retrained model with Transfer Learning for the localization of COVID-19 and development of a mobile application for lay audience.

Gantt Charts

FYP-I



FYP-2



References

[1] S. H. Kassania, P. H. Kassanib, M. J. Wesolowskic, K. A. Schneidera, and R. Detersa, "Automatic detection of coronavirus disease (covid-19) in x-ray and ct images: A machine learning based approach," *Biocybernetics and Biomedical Engineering*, vol. 41, no. 3, pp. 867–879, 2021. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S020852162100067X

[2] T. Zebin and S. Rezvy, "Covid-19 detection and disease progression visualization: Deep learning on chest x-rays for classification and coarse localization," *Applied Intelligence*, vol. 51, no. 2, pp. 1010–1021, 2021. [Online]. Available: https://link.springer.com/article/10.1007/s10489-020-01867-1

[3] L. O. Hall, R. Paul, D. B. Goldgof, and G. M. Goldgof, "Finding covid-19 from chest x-rays using deep learning on a small dataset," *arXiv preprint arXiv:2004.02060*, 2020. [Online]. Available: https://arxiv.org/abs/2004.02060