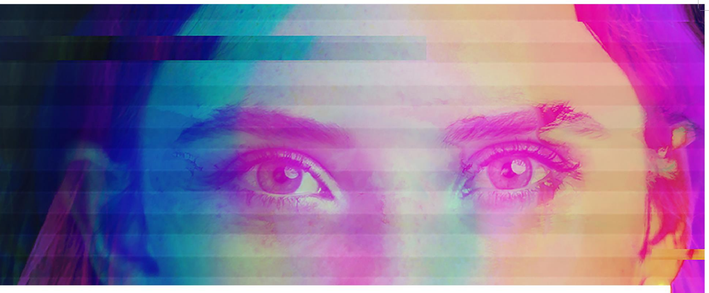
COVID or flu? That's the question!



INTRODUCTION

Motivation

Early diagnosis for COVID-19 is crucial to reducing the spread of the disease. However, as the number of cases begin to surge, many healthcare and testing facilities get overwhelmed with patients looking to get tested. The current testing strategy results in:

- Long queue times
- Delayed turnaround time for results
- Increased stress on both healthcare works and patients.

As a result, it is important to explore other avenues for COVID-19 detection. One of these methods, is to use machine learning (ML) models to detect COVID-19 in chest X-ray images. This new testing strategy could have the following benefits:

+ Higher testing accuracy
+ Quick turnaround time
+ Automated procedure.

Project Aim

To explore advanced image classification techniques to determine whether ML can be used to correctly identify COVID-19 in chest X-ray images.

METHODOLOGY

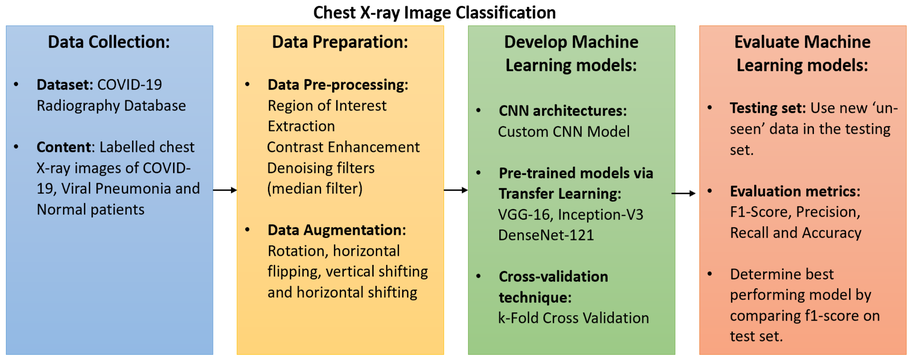


Figure 1. Methodology Diagram

Data Preparation

The pre-processing techniques used to enhance the features relevant to COVID-19 detection and denoise the chest X-rays include:

- Region of interest (ROI) extraction
- Contrast enhancement (CLAHE)
- Denoising filters (median filter)

Data Augmentation techniques such as rotation, horizontal flipping, vertical and horizontal shifting were used to generate additional data for training models.

Machine Learning

Various ML algorithms were trained and tested on the X-ray images, including: VGG-16, DenseNet121, InceptionNet101 and our very own custom CNN model. Cross validation were performed using the k-Fold Cross Validation method.

Figure 2. Raw image

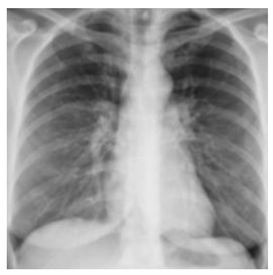


Figure 3. ROI applied image

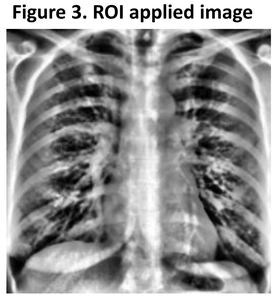


Figure 4. CLAHE and median filter applied image

OUTCOMES

The ML models were evaluated on a testing set that contained 'un-seen' data. F-1 score was used as the primary evaluation metric to compare the performances of the ML models.

Our results indicate that:

- The pre-trained ML models via transfer learning are more effective than our custom designed CNN model.
- The performance of all ML models improved by applying the pre-processing techniques.
- The ML model DenseNet121 outperformed all the other models by producing the best F1-score on the testing set.

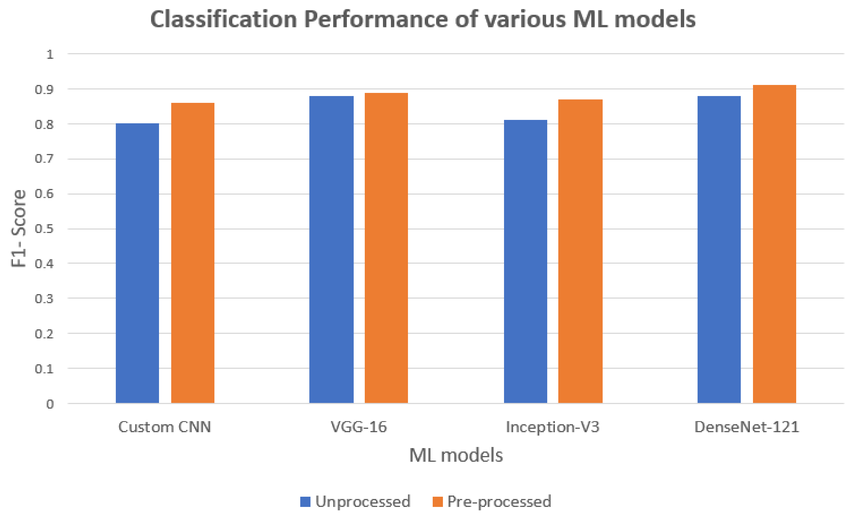


Figure 5. Classification performance of various machine learning models

Conclusion and Future Work

The ML models implemented are capable of correctly classifying and differentiating chest X-ray images of COVID-19, viral pneumonia and healthy patients with high accuracy. Future work involves modifying the pre-processing procedure and implementing other ML techniques such as Vision Transformer for X-ray classification. Furthermore, the models could be adapted to classify other lung diseases.

Nivin Jose Kovukunnel, Andreas Kotsanis & Mohammad Shafaie

Supervisors: Prof. Derek Abbott & Dr Mohsen Dorraki | Healthy Society | Can we train AI to detect COVID-19 | EEE-UG-13148 | 2022