Final Report-CoronaHack-Chest-X-Ray-Classify

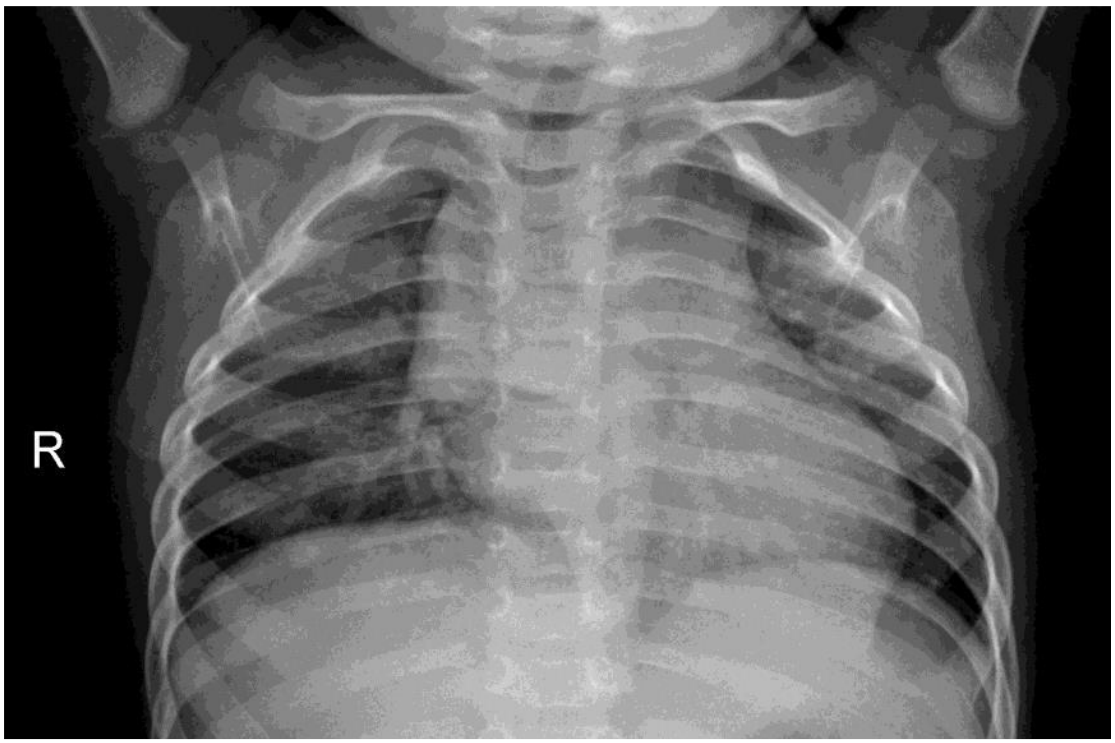
Abstract:

CoronaHack - Chest X-Ray Dataset is a chest X-ray dataset collected during the COVID-19 outbreak. The purpose of this dataset is to assist medical professionals in the diagnosis and treatment of patients with COVID-19. In this study, a convolutional neural network (CNN) was used to classify this dataset to assist in automated COVID-19 diagnosis. The results show that this CNN model has a high classification accuracy when performing two-class classification (Pnemonia,Normal), especially the detection accuracy of COVID-19 is as high as 94.55%. This study shows that using CNN can effectively classify chest X-rays and assist medical professionals in the diagnosis and treatment of COVID-19.

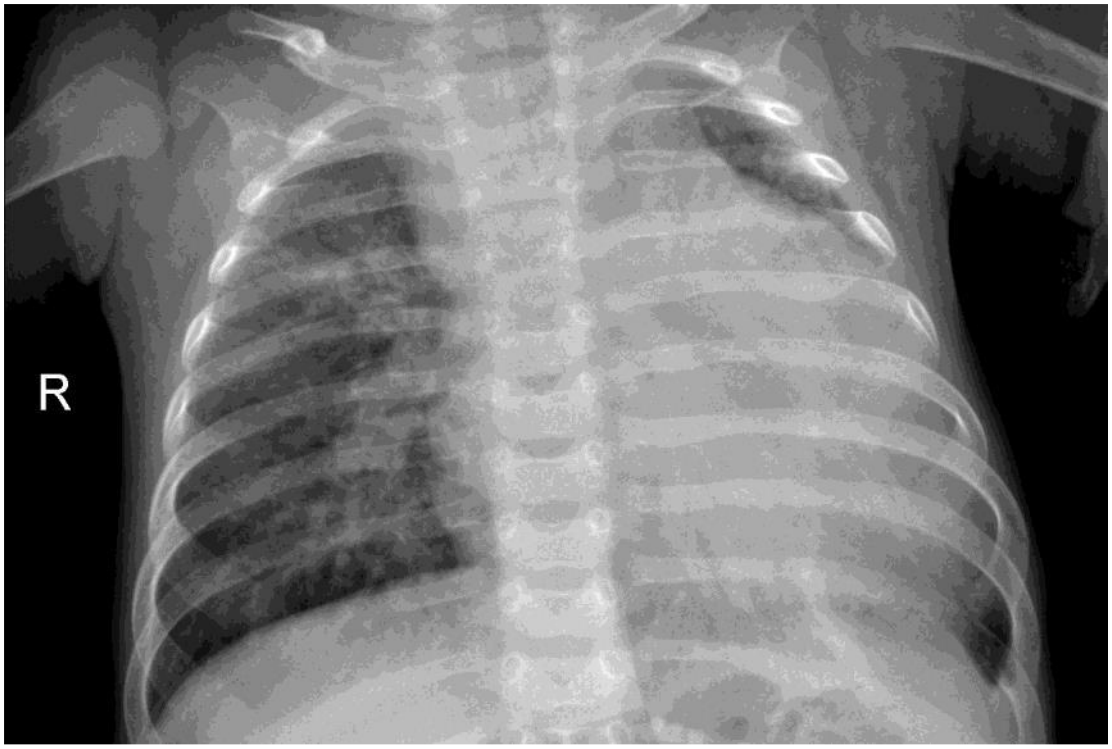
Introduction:

Corona COVID19 virus affects the respiratory system of healthy individual & Chest XRay is one of the important imaging methods to identify the corona virus.With the Chest XRay dataset, Develop a Machine Learning Model to classify the X Rays of Healthy vs Pneumonia (Corona) affected patients & this model powers the AI application to test the Corona Virus in Faster Phase.

The training set has a total of 5286 images, 3944 images of the diseased and 1342 images of the non-diseased. The test set has a total of 624 images, 390 images with disease and 234 images without disease.



Picture-1:Normal



Picture-2: Pnemonia

Method:

In this study, we employ various convolutional neural network models to classify the CoronaHack - Chest X-Ray Dataset. These models include Xception, VGG16, VGG19, ResNet101V2, InceptionV3, InceptionResNetV2, EfficientNetV2S, and EfficientNetV2M and self define.

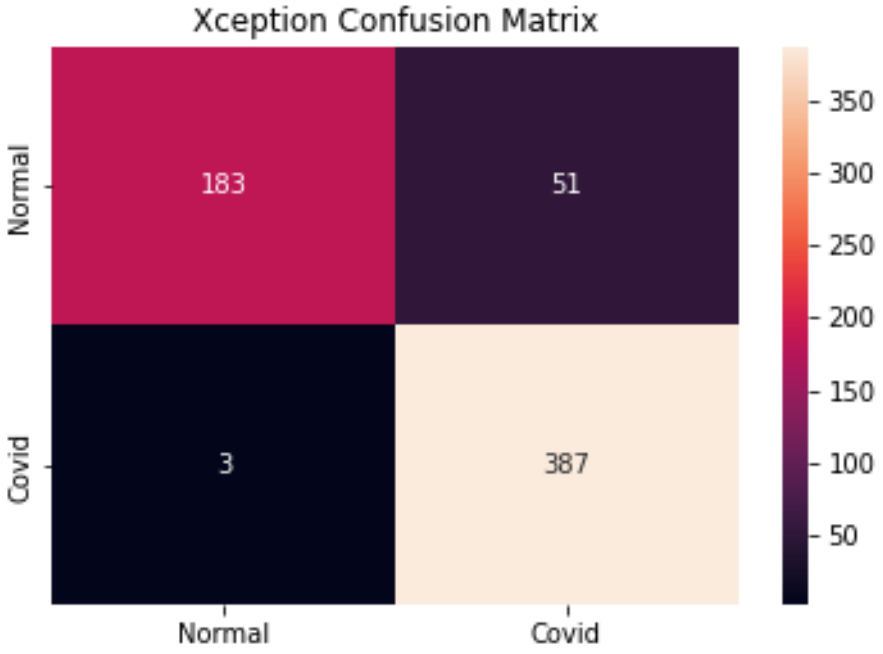
These models are all trained on ImageNet and have good image recognition capabilities. We use these pre trained models to classify pneumonia and normal chest radiographs. By fine tuning the weights of these pre trained models, we can apply these models to our classification tasks and can effectively improve the classification accuracy of the models.

Because the database is limited, we use image enhancement technology (random scaling and random brightness adjustment and random movement of height and width), the optimizer uses Adamax, the learning rate is 0.0001, and the training is 100 times.

Experiment and Results:

The accuracy of this Xception model is as high as 91.34%.

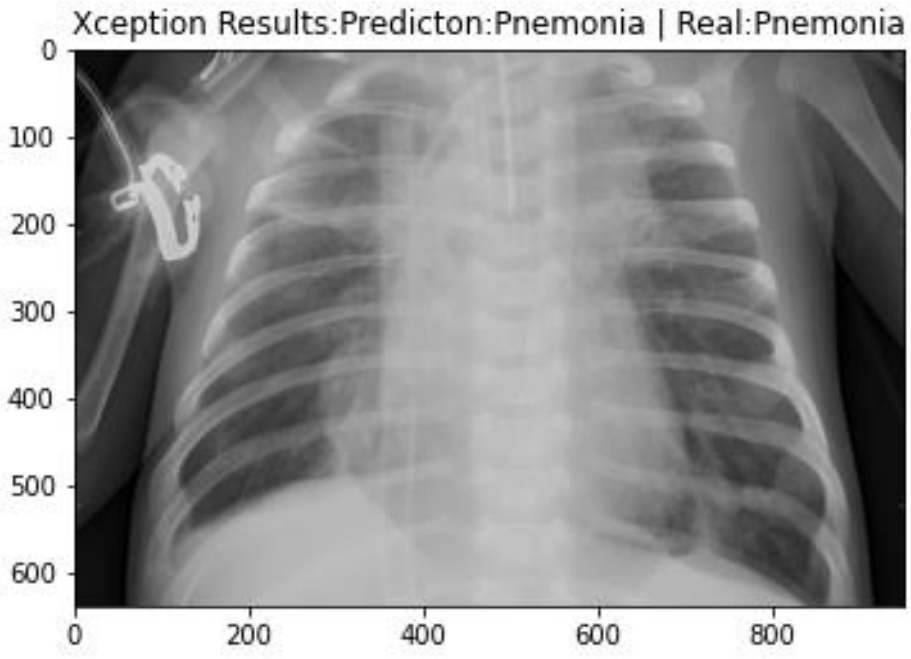
Picture-3: Xception Model Training History



Picture-4: Xception Model Classifier Confusion Matrix

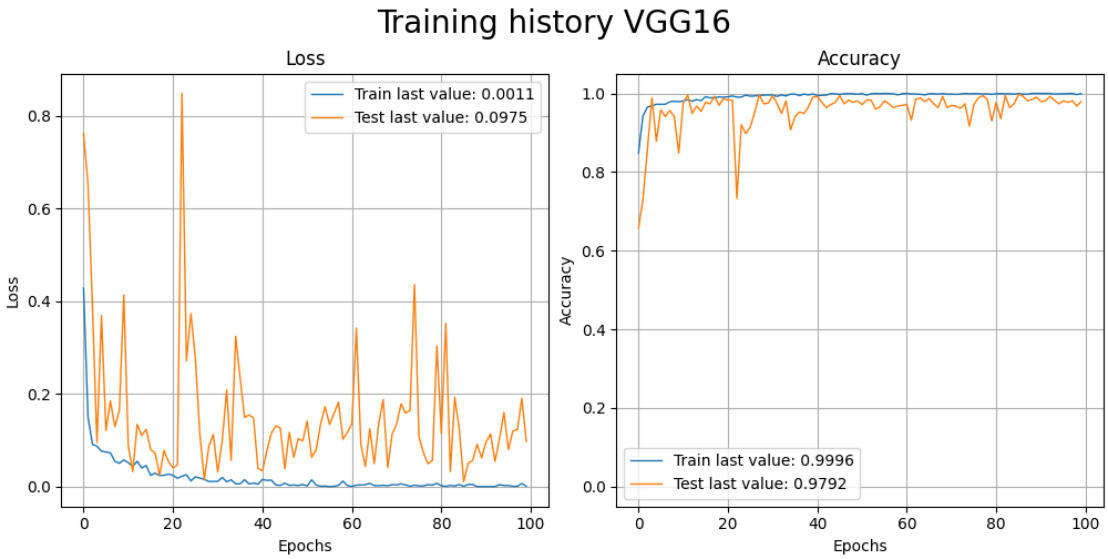
```
Results on test set:
------------------------------------------------------------
Accuracy:0.9134615384615384
------------------------------------------------------------
F1-Score:0.9110248447204969
------------------------------------------------------------
Recall:0.9134615384615384
------------------------------------------------------------
Precision:0.921177640300486
------------------------------------------------------------
ROC AUC score: 0.8871794871794871
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.98      0.78      0.87       234
       Covid       0.88      0.99      0.93       390

    accuracy                           0.91       624
   macro avg       0.93      0.89      0.90       624
weighted avg       0.92      0.91      0.91       624
```

Picture-5: Xception Model Testset Classify Result

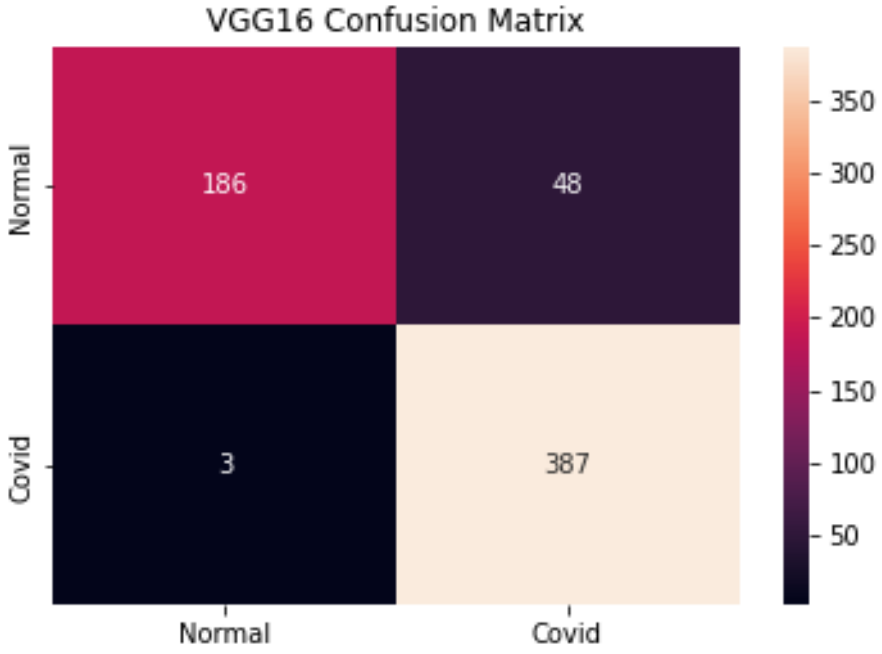


Picture-6: Xception Model Predict Result

The accuracy of this VGG16 model is as high as 91.82%.



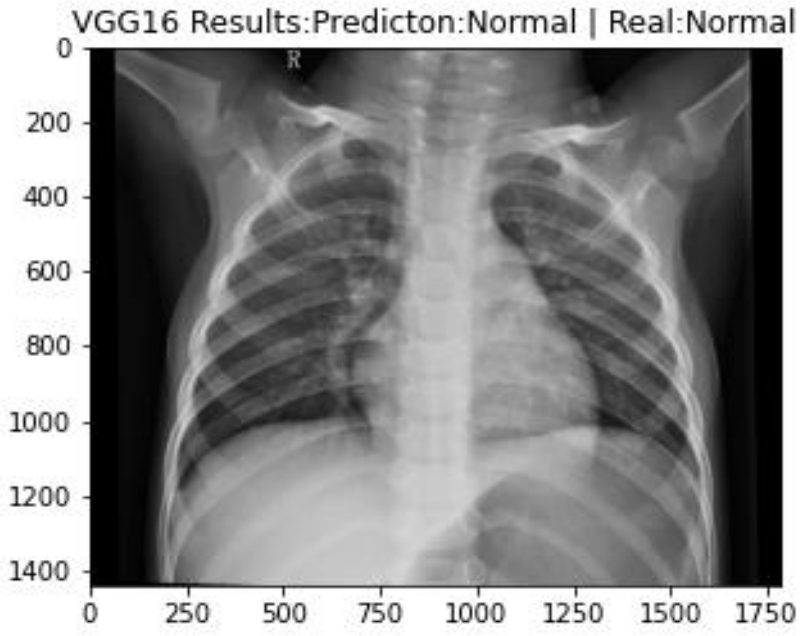
Picture-7: VGG16 Model Training History



Picture-8: VGG16 Model Classifier Confusion Matrix

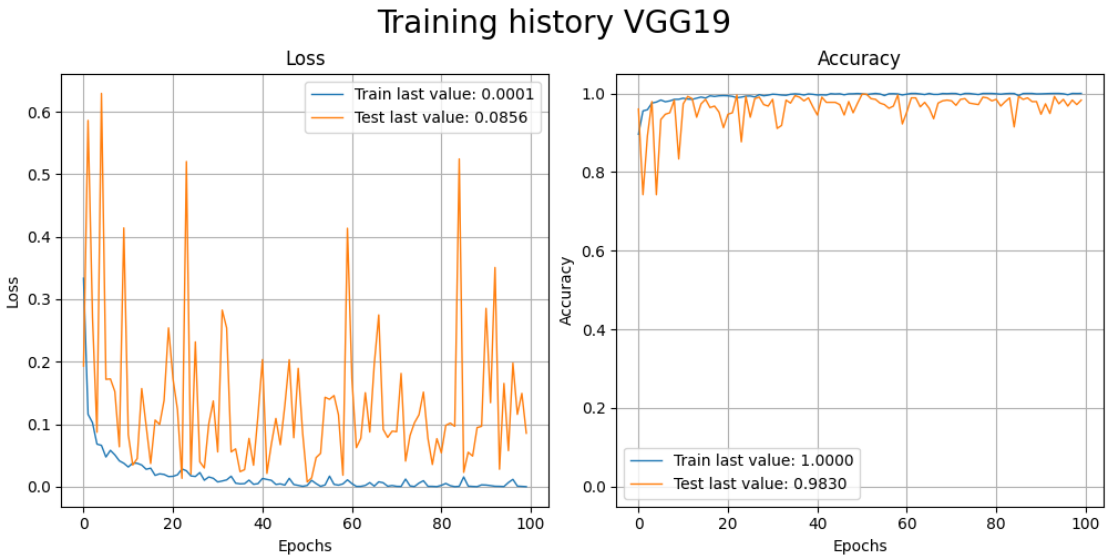
```
Results on test set:
------------------------------------------------------------
Accuracy:0.9182692307692307
------------------------------------------------------------
F1-Score:0.9161508704061896
------------------------------------------------------------
Recall:0.9182692307692307
------------------------------------------------------------
Precision:0.9250821018062396
------------------------------------------------------------
ROC AUC score: 0.8935897435897437
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.98      0.79      0.88       234
       Covid       0.89      0.99      0.94       390

    accuracy                           0.92       624
   macro avg       0.94      0.89      0.91       624
weighted avg       0.93      0.92      0.92       624
```

Picture-9: VGG16 Model Testset Classify Result

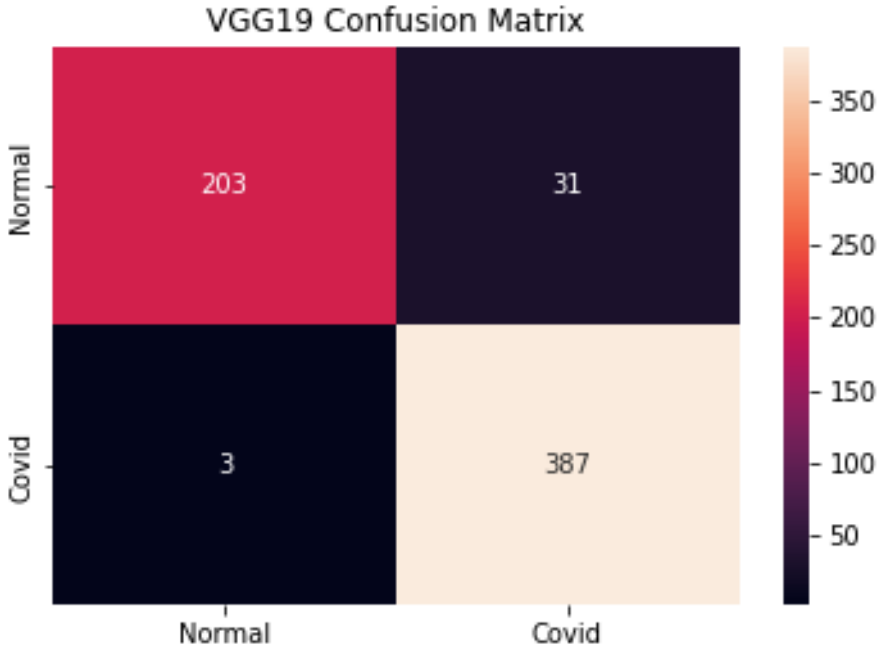


Picture-10: VGG16 Model Predict Result

The accuracy of this VGG19 model is as high as 94.55%



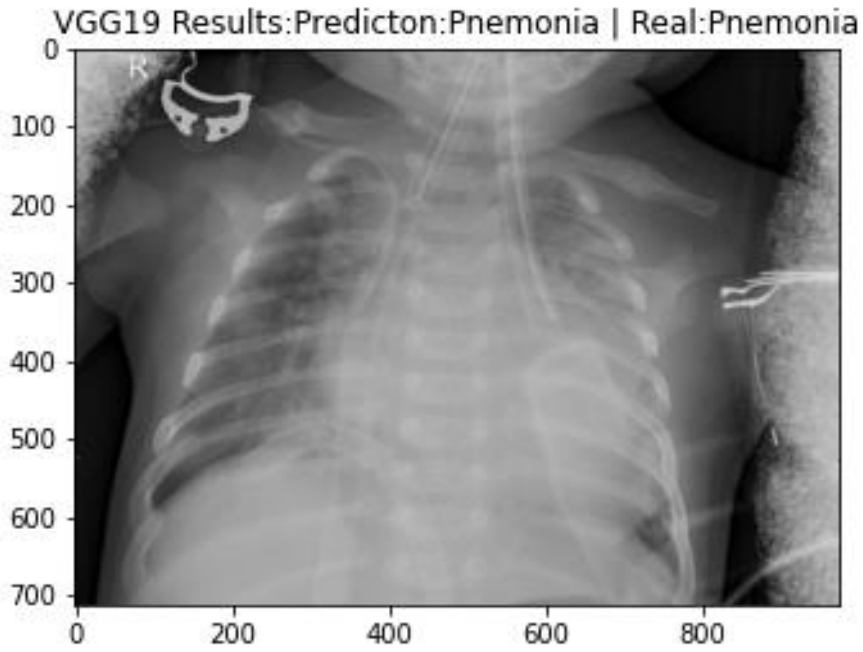
Picture-11: VGG19 Model Training History



Picture-12: VGG19 Model Classifier Confusion Matrix

```
Results on test set:
------------------------------------------------------------
Accuracy:0.9455128205128205
------------------------------------------------------------
F1-Score:0.9447232223222323
------------------------------------------------------------
Recall:0.9455128205128205
------------------------------------------------------------
Precision:0.9481871603103079
------------------------------------------------------------
ROC AUC score: 0.9299145299145299
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.99      0.87      0.92       234
       Covid       0.93      0.99      0.96       390

    accuracy                           0.95       624
   macro avg       0.96      0.93      0.94       624
weighted avg       0.95      0.95      0.94       624
```

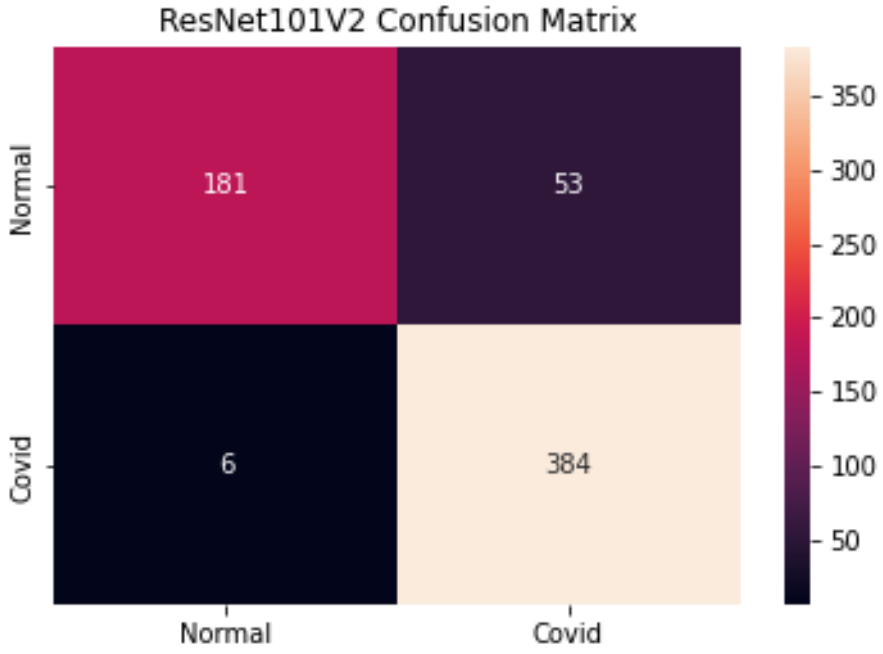
Picture-13: VGG19 Model Testset Classify Result



Picture-14: VGG19 Model Predict Result

The accuracy of this ResNet101V2 model is as high as 90.54%.

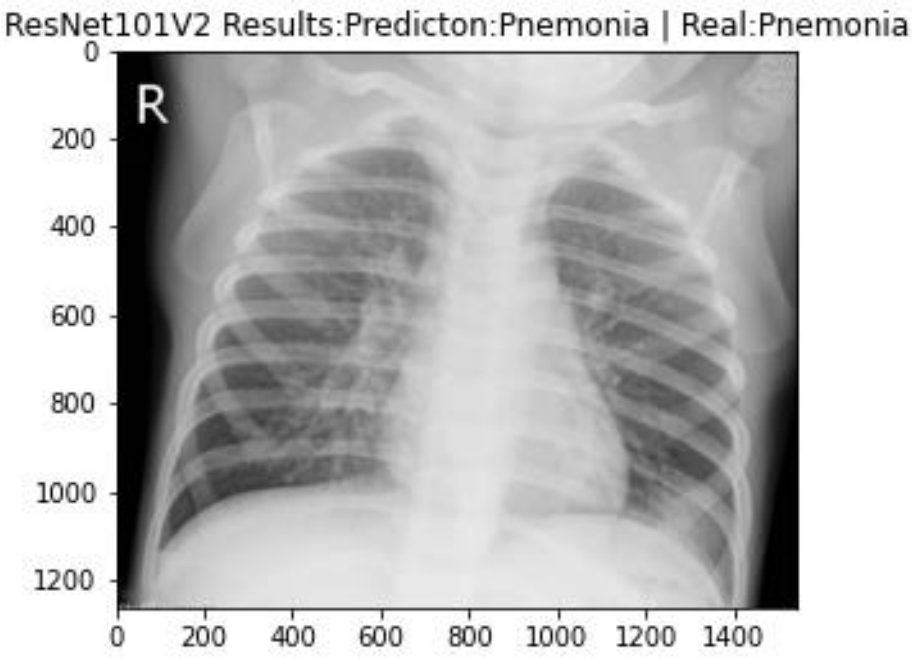
Picture-15:Resnet101V2 Model Training History



Picture-16: Resnet101V2 Model Classifier Confusion Matrix

```
Results on test set:
------------------------------------------------------------
Accuracy:0.905448717948718
------------------------------------------------------------
F1-Score:0.9028576803660312
------------------------------------------------------------
Recall:0.905448717948718
------------------------------------------------------------
Precision:0.912166999106695
------------------------------------------------------------
ROC AUC score: 0.879059829059829
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.97      0.77      0.86       234
       Covid       0.88      0.98      0.93       390

    accuracy                           0.91       624
   macro avg       0.92      0.88      0.89       624
weighted avg       0.91      0.91      0.90       624
```

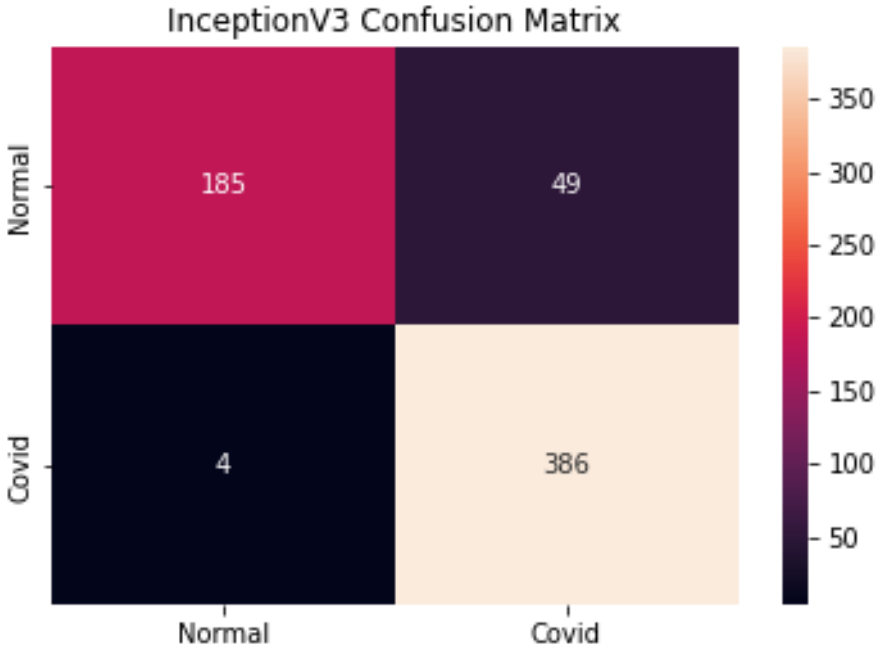
Picture-17: Resnet101V2 Model Testset Classify Result



Picture-18:Resnet101V2 Model Predict Result

The accuracy of this InceptionV3 model is as high as 91.50%.

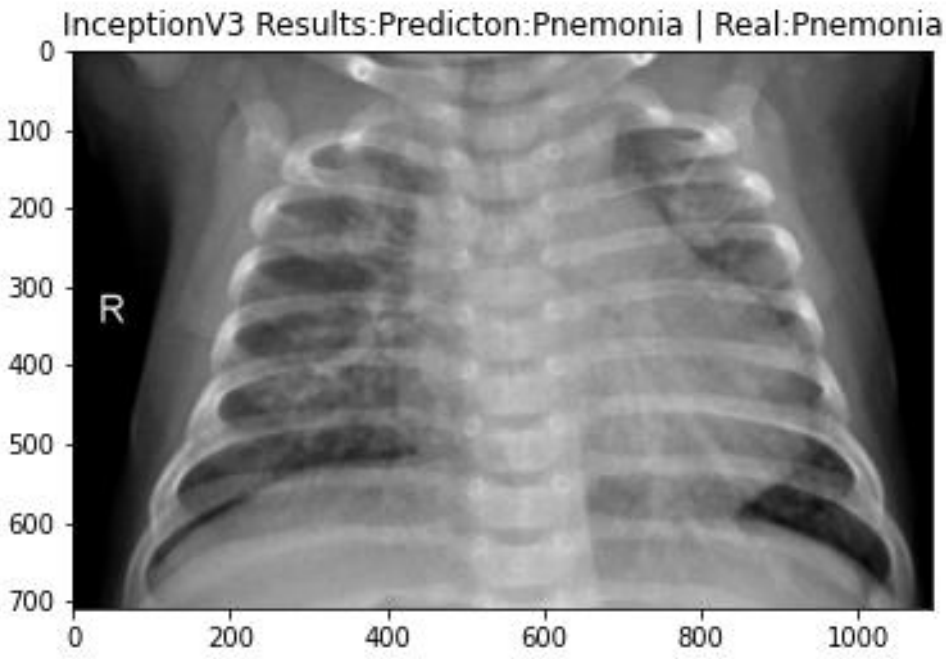
Picture-19:InceptionV3 Model Training History



Picture-20: InceptionV3 Model Classifier Confusion Matrix

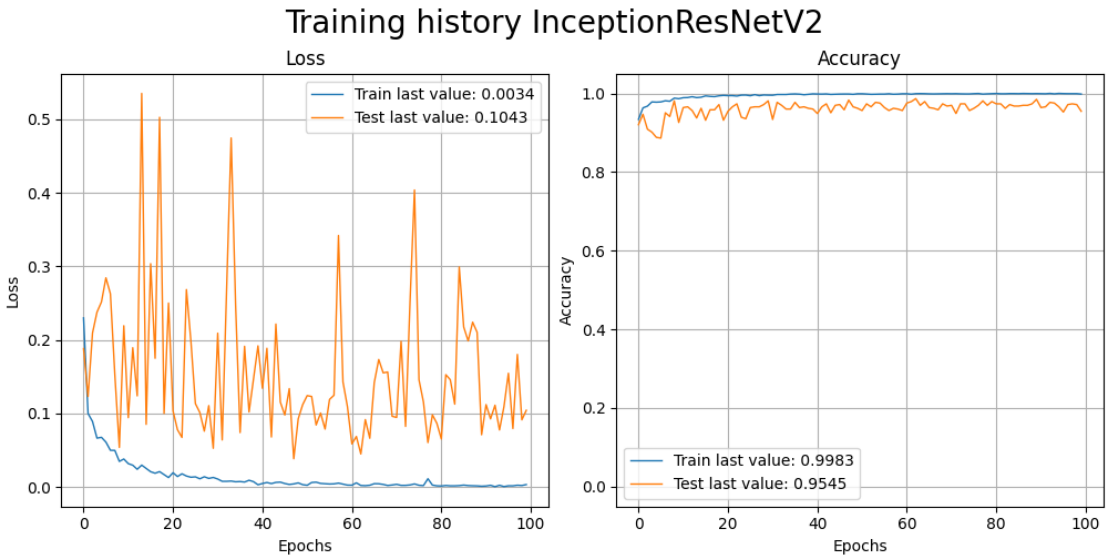
```
Results on test set:
------------------------------------------------------------
Accuracy:0.9150641025641025
------------------------------------------------------------
F1-Score:0.9128626692456481
------------------------------------------------------------
Recall:0.9150641025641025
------------------------------------------------------------
Precision:0.9216611932129174
------------------------------------------------------------
ROC AUC score: 0.8901709401709401
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.98      0.79      0.87       234
       Covid       0.89      0.99      0.94       390

    accuracy                           0.92       624
   macro avg       0.93      0.89      0.91       624
weighted avg       0.92      0.92      0.91       624
```

Picture-21: InceptionV3 Model Testset Classify Result

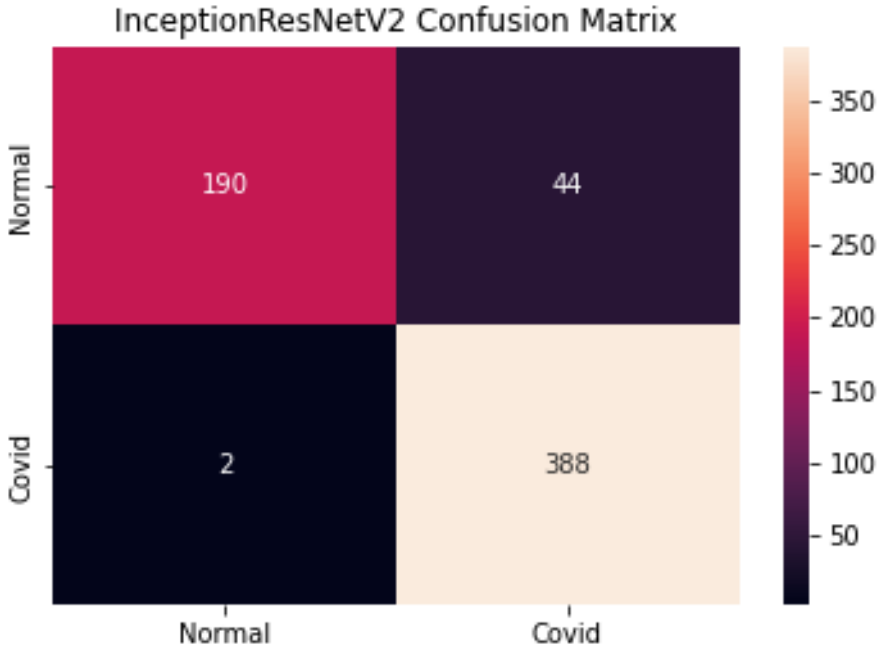


Picture-22: InceptionV3 Model Predict Result

The accuracy of this InceptionResNetV2 model is as high as 92.46%.



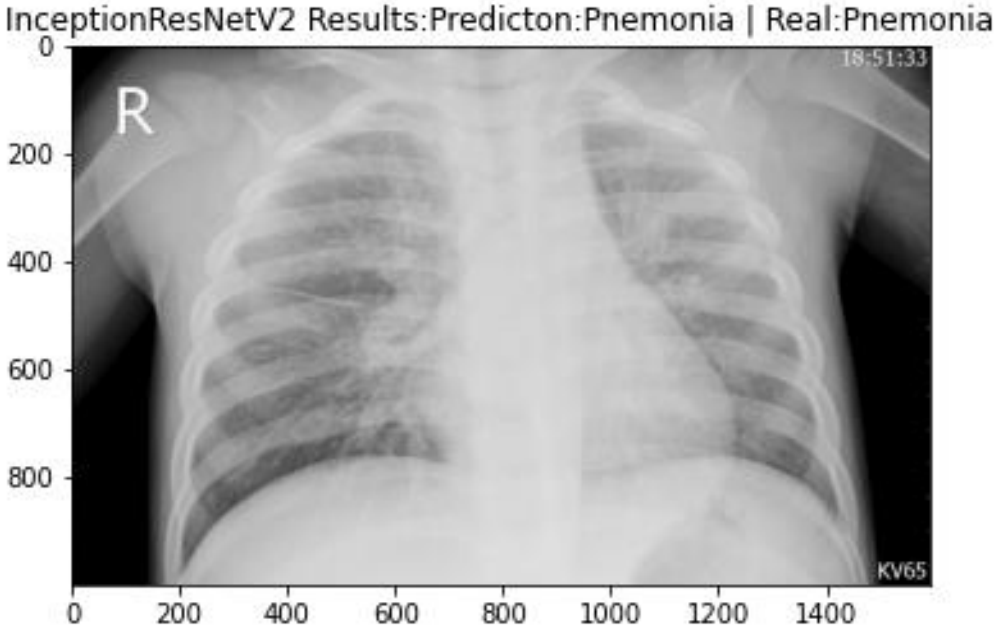
Picture-23:InceptionResNetV2 Model Training History



Picture-24: InceptionResNetV2 Model Classifier Confusion Matrix

```
Results on test set:
------------------------------------------------------------
Accuracy:0.9246794871794872
------------------------------------------------------------
F1-Score:0.9228368236723609
------------------------------------------------------------
Recall:0.9246794871794872
------------------------------------------------------------
Precision:0.9311194878057628
------------------------------------------------------------
ROC AUC score: 0.9012820512820513
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.99      0.81      0.89       234
       Covid       0.90      0.99      0.94       390

    accuracy                           0.92       624
   macro avg       0.94      0.90      0.92       624
weighted avg       0.93      0.92      0.92       624
```

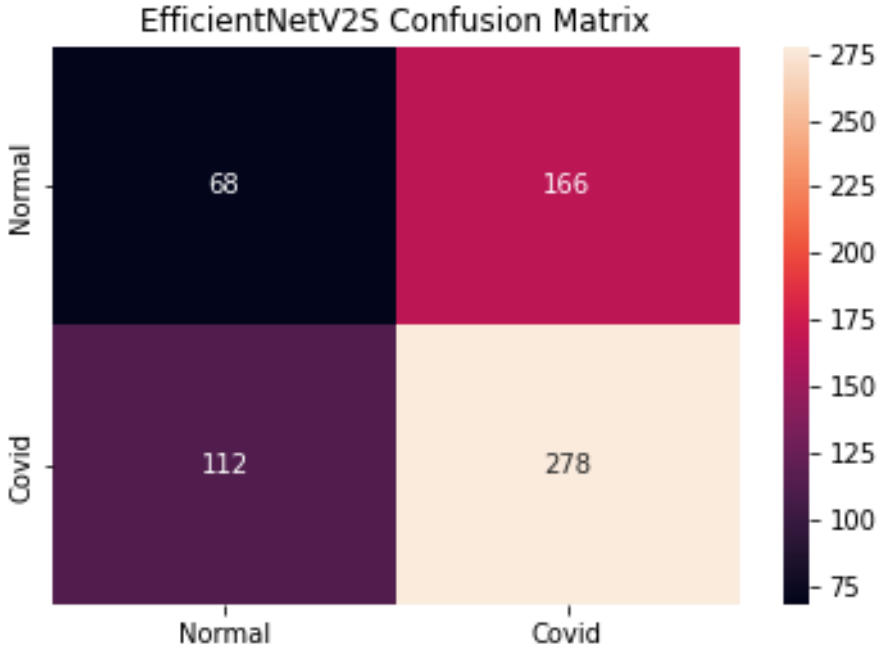
Picture-25: InceptionResNetV2 Model Testset Classify Result



Picture-26: InceptionResNetV2 Model Predict Result

The accuracy of this EfficientNetV2S model is as high as 90.70%.

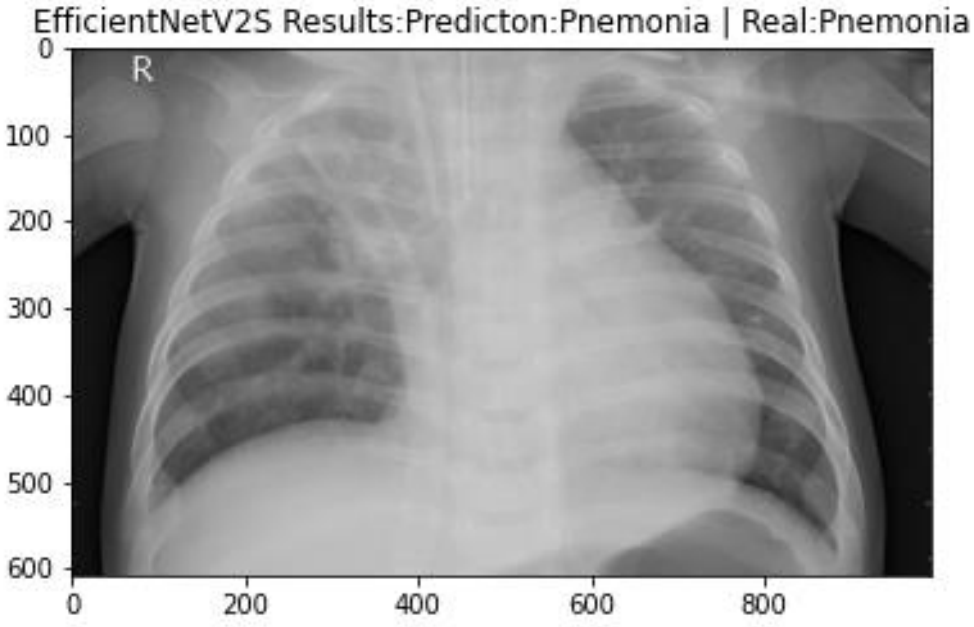
Picture-27:EfficientNetV2S Model Training History



Picture-28: EfficientNetV2S Model Classifier Confusion Matrix

```
Results on test set:
------------------------------------------------------------
Accuracy:0.907051282051282
------------------------------------------------------------
F1-Score:0.9042918083818529
------------------------------------------------------------
Recall:0.907051282051282
------------------------------------------------------------
Precision:0.915143280632411
------------------------------------------------------------
ROC AUC score: 0.8794871794871795
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.98      0.77      0.86       234
       Covid       0.88      0.99      0.93       390

    accuracy                           0.91       624
   macro avg       0.93      0.88      0.90       624
weighted avg       0.92      0.91      0.90       624
```

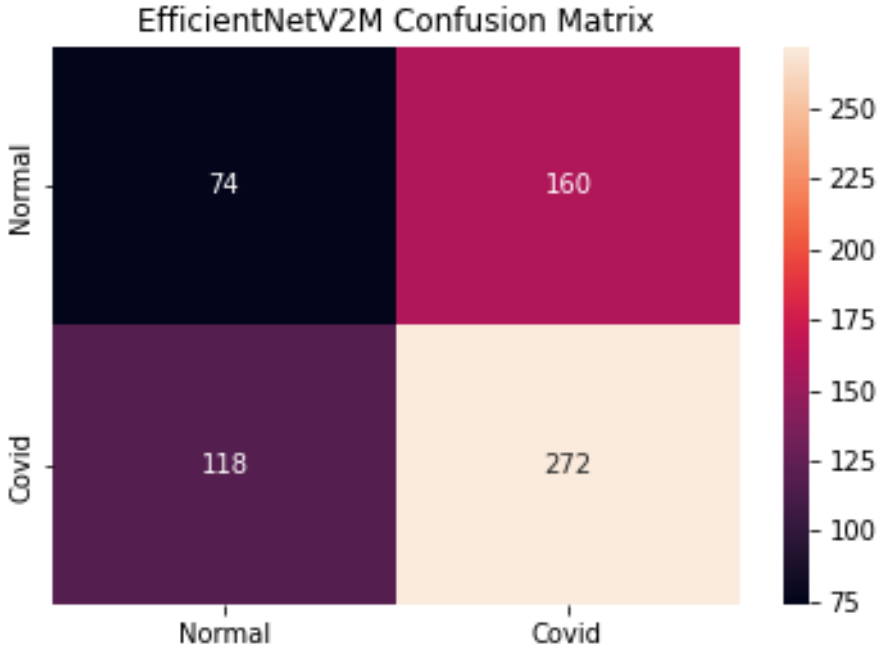
Picture-29: EfficientNetV2S Model Testset Classify Result



Picture-30: EfficientNetV2S Model Predict Result

The accuracy of this EfficientNetV2M model is as high as 92.30%.

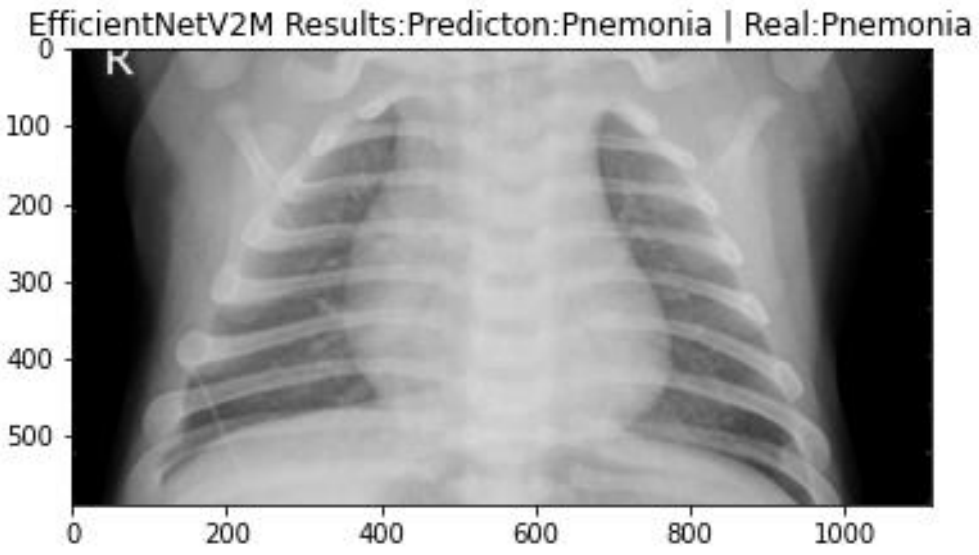
Picture-31:EfficientNetV2M Model Training History



Picture-32: EfficientNetV2M Model Classifier Confusion Matrix

```
Results on test set:
------------------------------------------------------------
Accuracy:0.9230769230769231
------------------------------------------------------------
F1-Score:0.9212501285082758
------------------------------------------------------------
Recall:0.9230769230769231
------------------------------------------------------------
Precision:0.9290364583333334
------------------------------------------------------------
ROC AUC score: 0.9
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.98      0.81      0.89       234
       Covid       0.90      0.99      0.94       390

    accuracy                           0.92       624
   macro avg       0.94      0.90      0.91       624
weighted avg       0.93      0.92      0.92       624
```

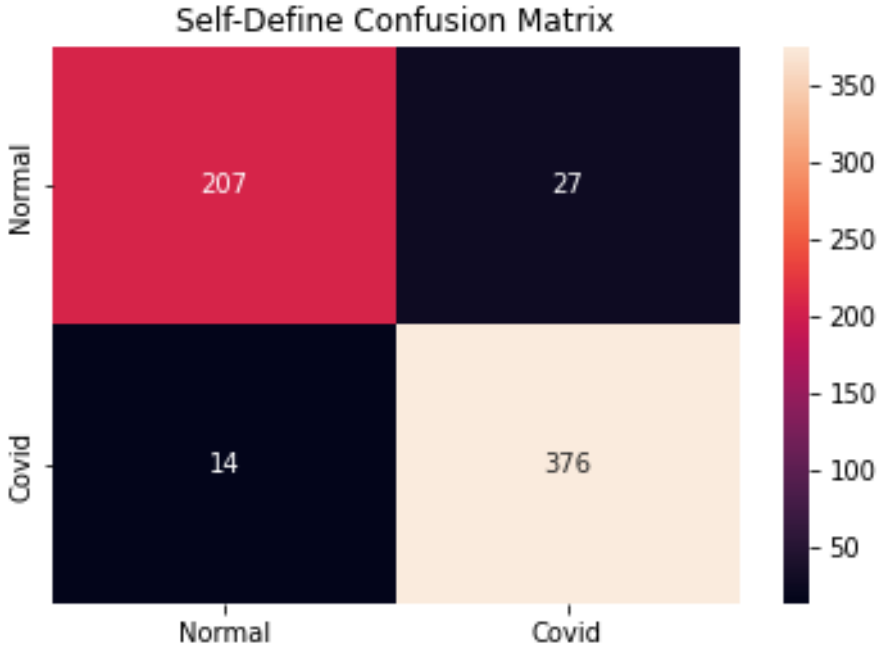
Picture-33: EfficientNetV2M Model Testset Classify Result



Picture-34: EfficientNetV2M Model Predict Result

The accuracy of this Self-Define model is as high as 93.42%.

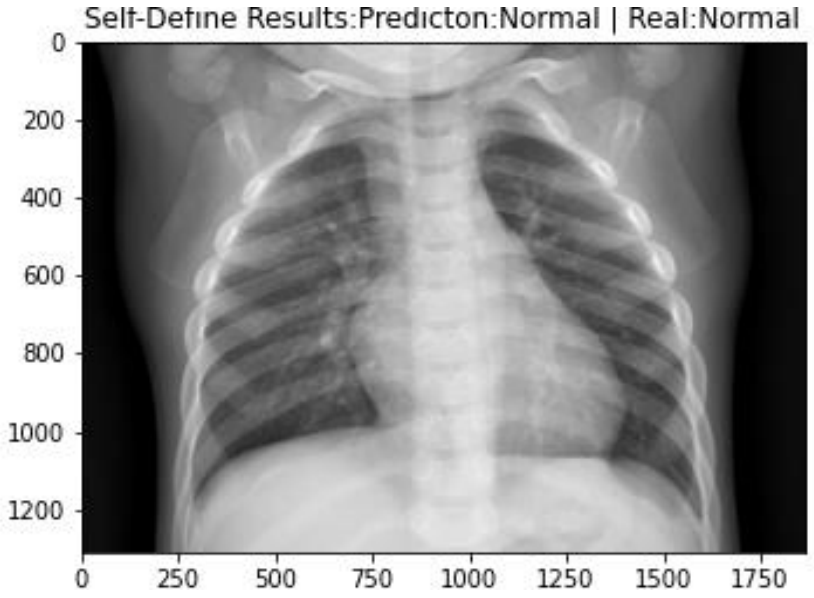
Picture-35: Self-Define Model Training History



Picture-36: Self-Define Model Classifier Confusion Matrix

```
Results on test set:
------------------------------------------------------------
Accuracy:0.9342948717948718
------------------------------------------------------------
F1-Score:0.9338947937308593
------------------------------------------------------------
Recall:0.9342948717948718
------------------------------------------------------------
Precision:0.934370894759889
------------------------------------------------------------
ROC AUC score: 0.9243589743589744
------------------------------------------------------------
              precision    recall  f1-score   support

      Normal       0.94      0.88      0.91       234
       Covid       0.93      0.96      0.95       390

    accuracy                           0.93       624
   macro avg       0.93      0.92      0.93       624
weighted avg       0.93      0.93      0.93       624
```

Picture-37: Self-Define Model Testset Classify Result



Picture-38: Self-Define Model Predict Result

Conclusion:

In this study, we used multiple convolutional neural network (CNN) models to classify the CoronaHack - Chest X-Ray Dataset collected during the COVID-19 pandemic, with the aim of assisting in the automation of COVID-19 diagnosis. Through experimental comparisons of various models, we found that the VGG19 model had the highest classification accuracy, followed by the Self-Define, InceptionResNetV2, and EfficientNetV2M models. The COVID-19 detection accuracy of these models reached an extremely high level.

These results indicate that CNN models have high accuracy in classifying chest

XRays, which can effectively assist medical professionals in diagnosing and treating COVID 19. In addition,this study provides an open and reliable chest XRays dataset, which can promote the development and progress of related research.

In the future, we can further study how to optimize the performance of these models and develop more effective automated COVID 19 diagnosis systems to address the challenges of the COVID 19 pandemic.