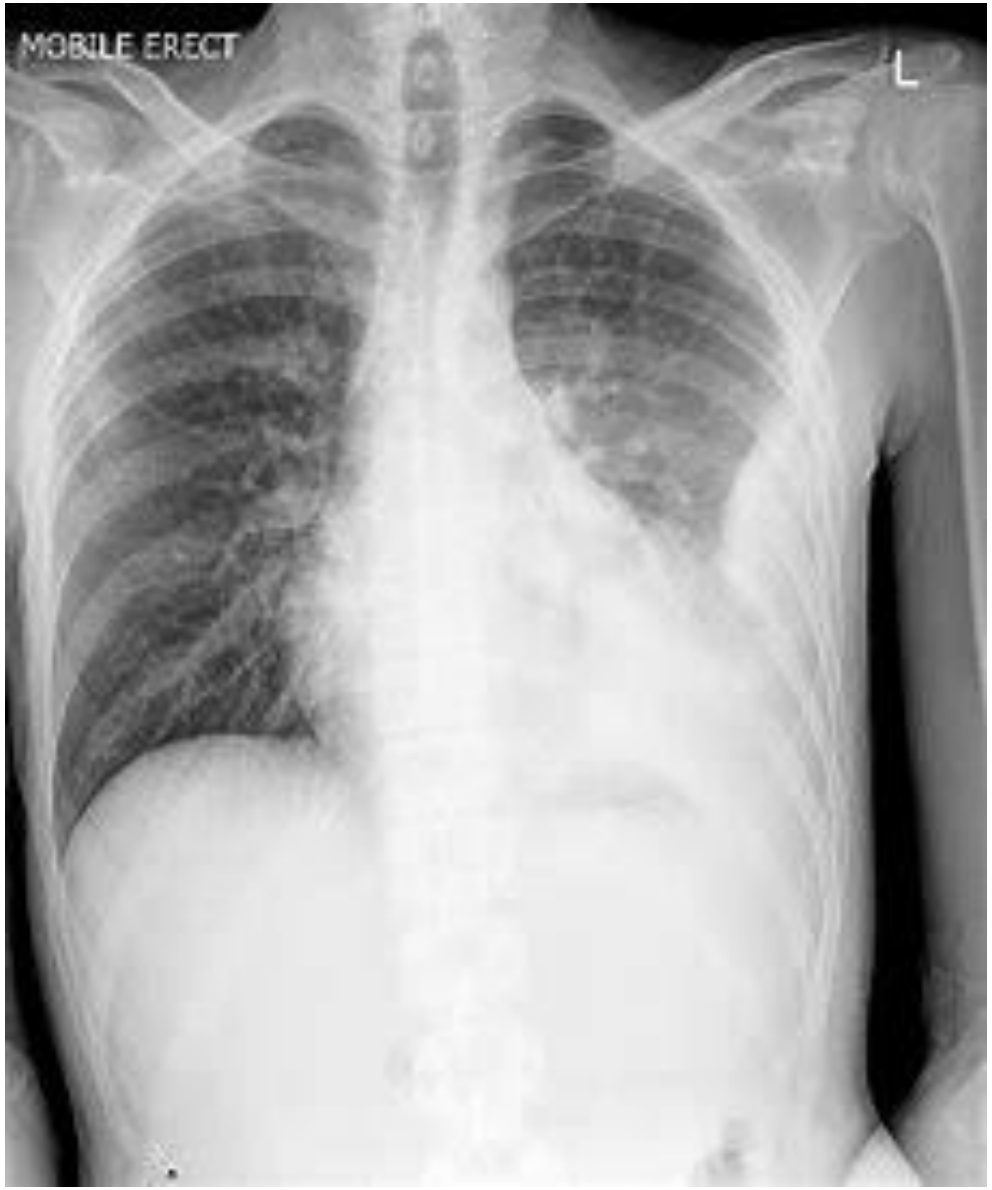


Pneumonia Detection in Chest X-Rays

Meghna Jayakar

Problem Statement

Pneumonia is an inflammatory condition of the lung primarily affecting the small air sacs (alveoli). Symptoms typically include some combination of dry cough, chest pain, fever, and difficulty breathing.

It is one of the highly ranked causes of death with over 4 million fatalities yearly. It has many variants: viral, bacterial or fungal.

Interpreting chest X rays to diagnose the condition is a time-consuming process and depends on the skill and experience of the diagnostician. Early diagnosis and treatment would allow for better patient outcomes.

However, we can use deep learning and computer vision to build a fast and easy tool that will assist doctors detect the condition.

This research aims to conduct a comparative analysis between the ResNet50 model, and a novel deep learning model designed for pneumonia detection in chest X-rays.

Traditional Techniques used for detecting Pneumonia

Traditional Techniques for Diagnosis

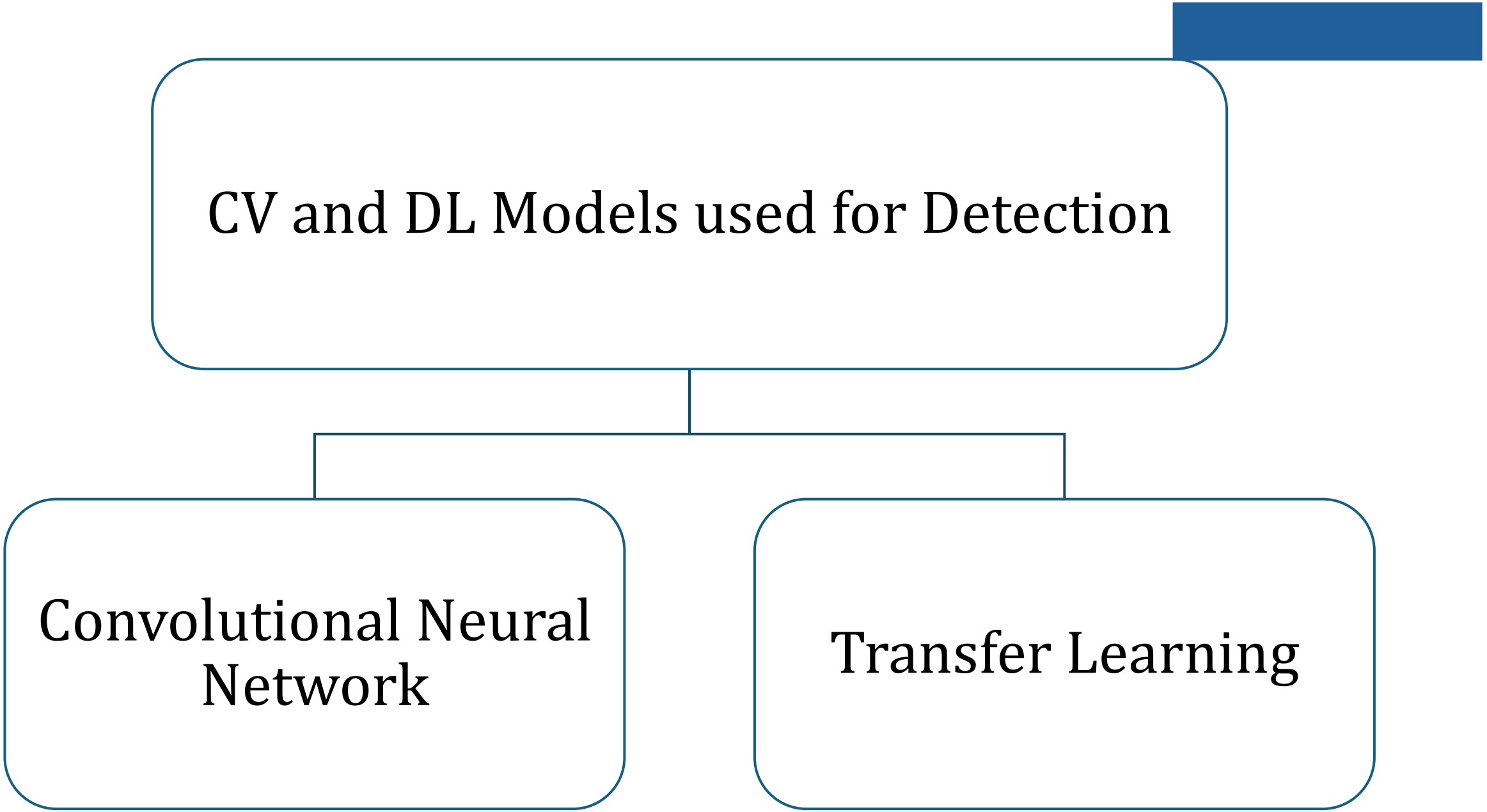
- Visual analysis of chest X-rays to find regions/patterns like opacities that indicate fluid buildup in the lungs.

- CT Scans were used in cases where the diagnosis is unclear or there are suspected complications.

Relevance of Computer Vision for Detection

- Efficiency: CV can automate the analysis of chest x-rays, aiding doctors and potentially leading to faster diagnoses.
- Objectivity: Deep learning models can analyze X-rays with greater consistency.
- Potential for early detection: CV models may identify pneumonia earlier than humans by analyzing subtle patterns.

CV Techniques Used


CV and DL Models used for Detection
Convolutional Neural Network
Transfer Learning

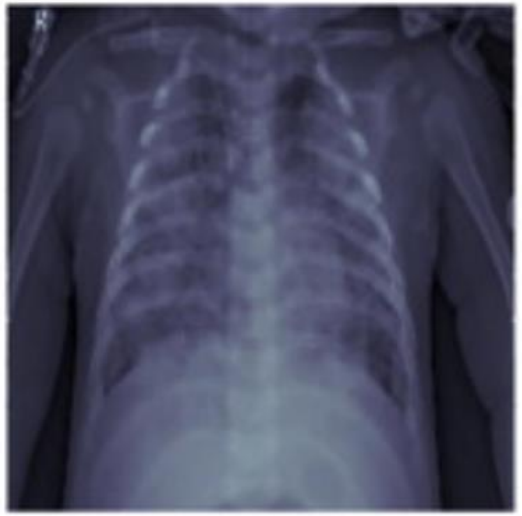
Data

- Chest X-rays taken from Guangzhou Women and Children's Medical Center, verified by medical experts.
- Contains 5856 labeled images.
- 4273 showed Pneumonia Positive while 1583 were negatives.
- Image dimensions varied from 1346 × 1044 to 2090 × 1858. All images were transformed to 224 × 224 × 3 size.

Normal

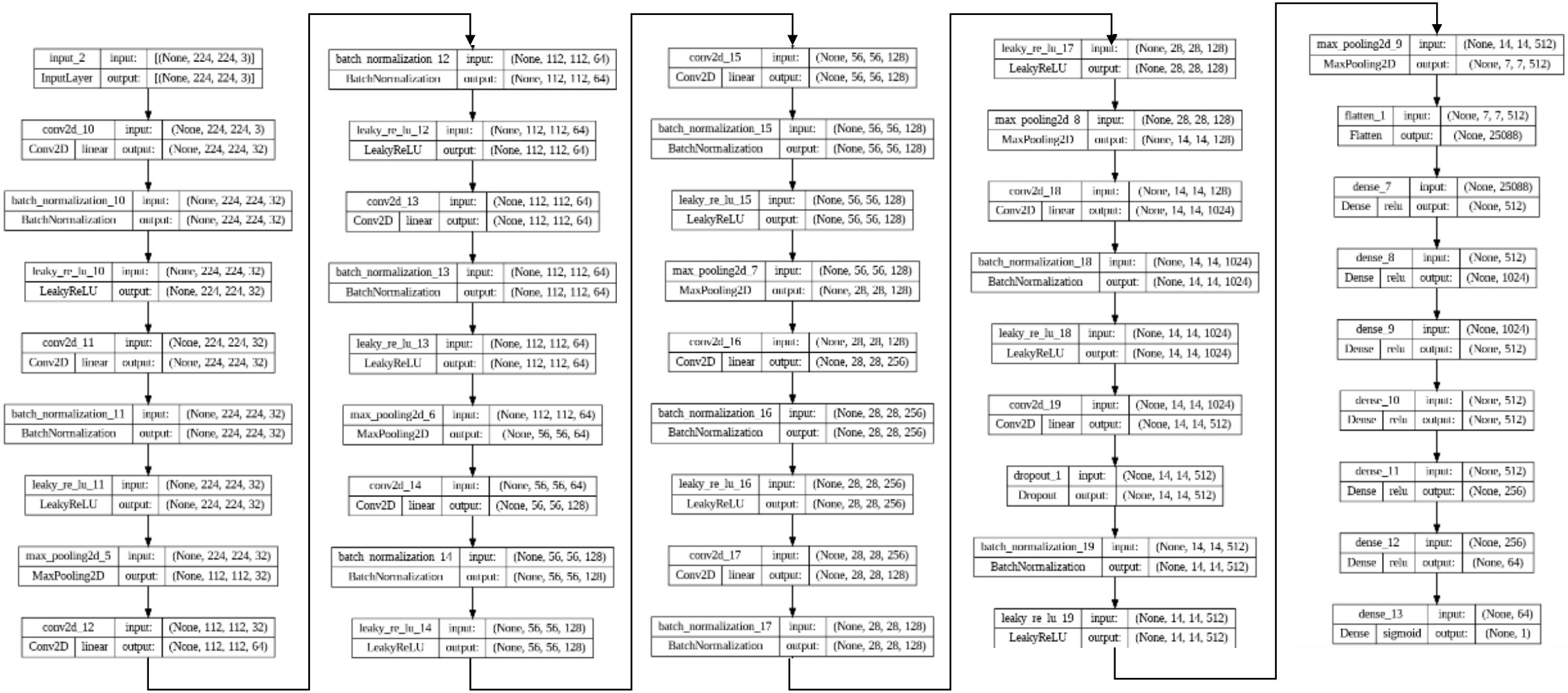
Pneumonia

Pneumonia

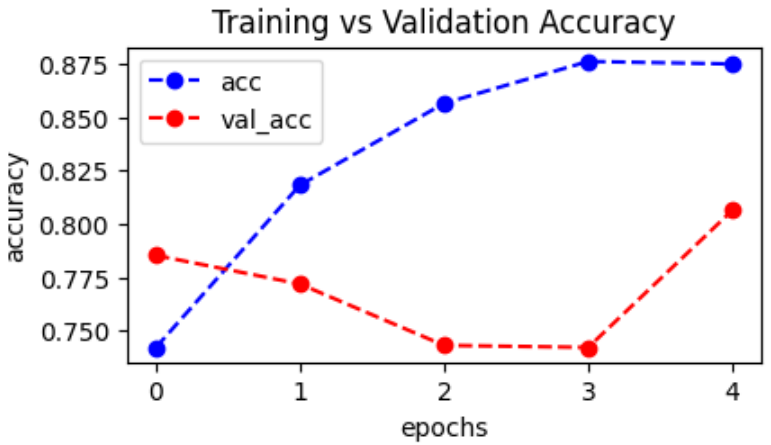


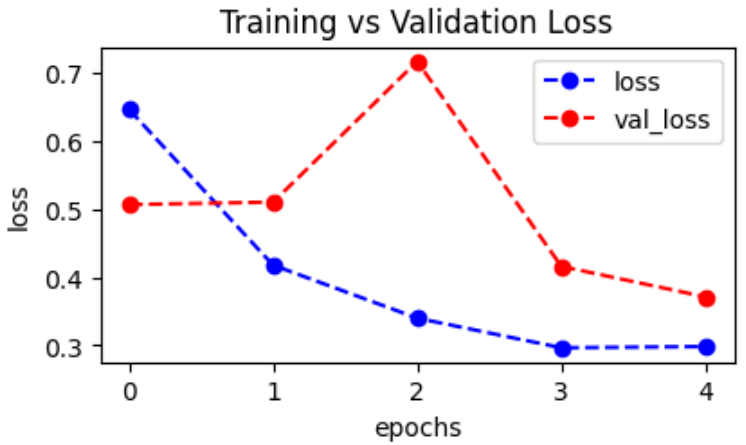
Normal

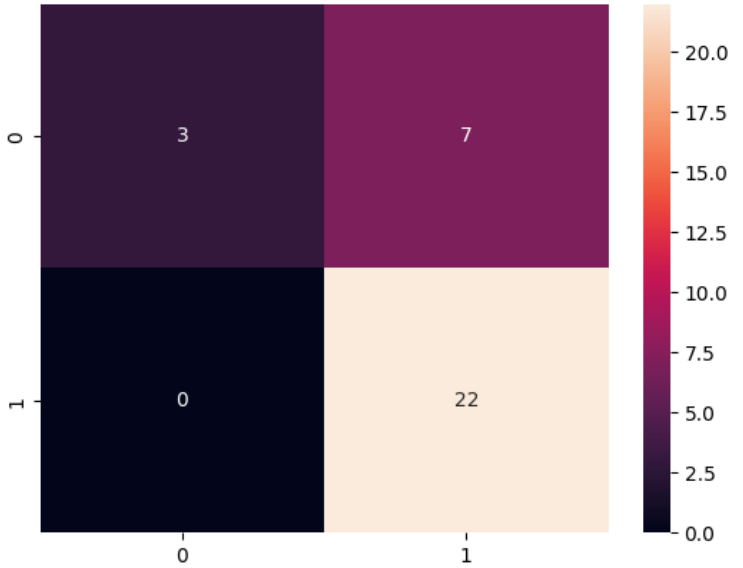
Convolutional Neural Network Model Architecture



CNN Model Performance



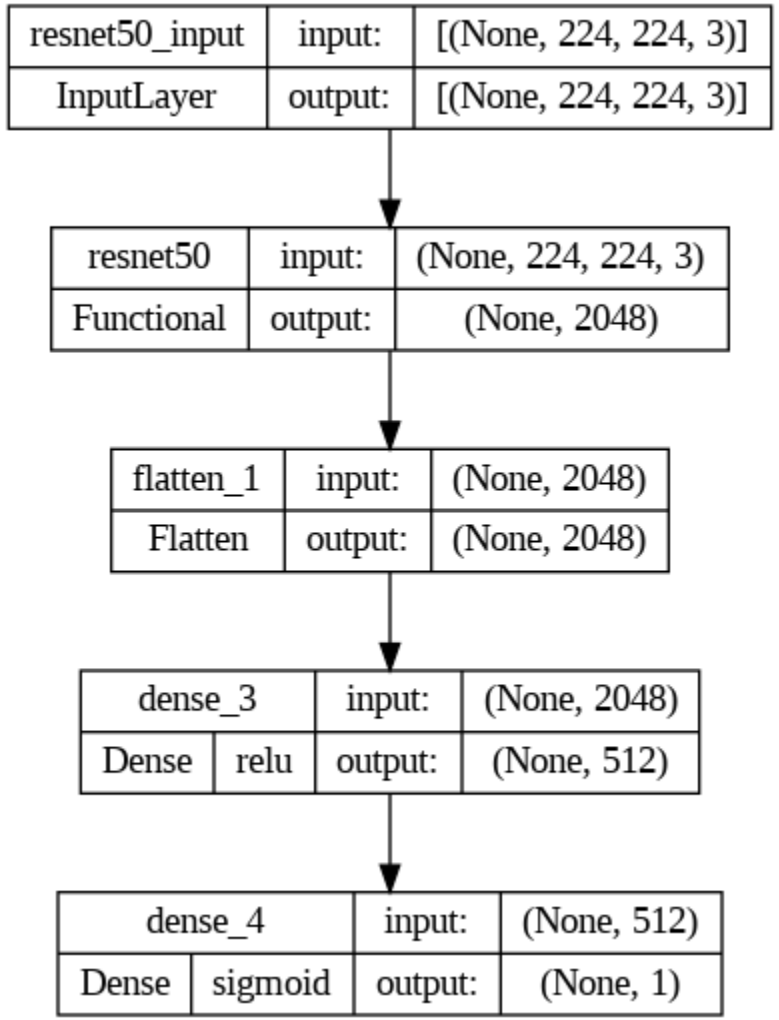




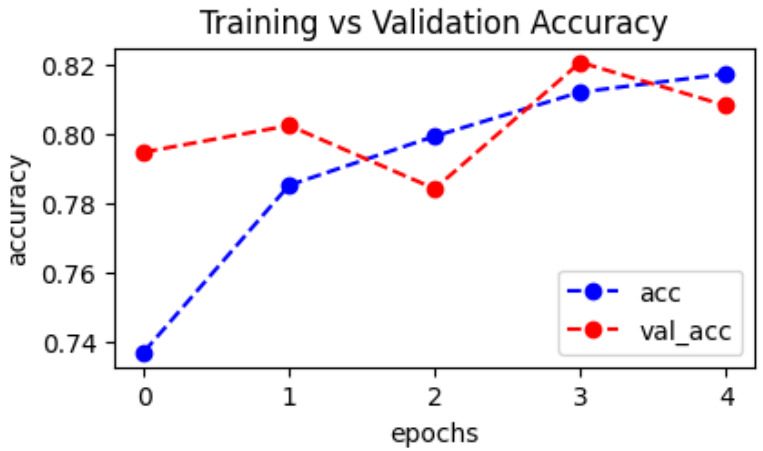

```
loss, acc = model.evaluate(test_data_iterator)
```

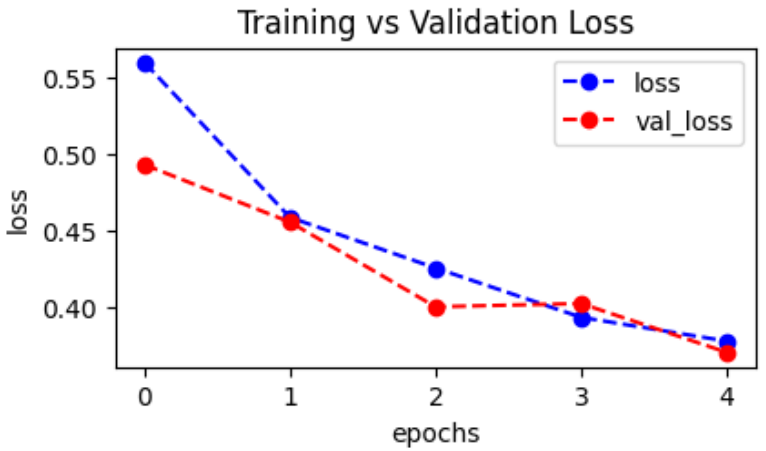
```
20/20 [==============================] - 7s 367ms/step - loss: 0.6083 - accuracy: 0.6506
```

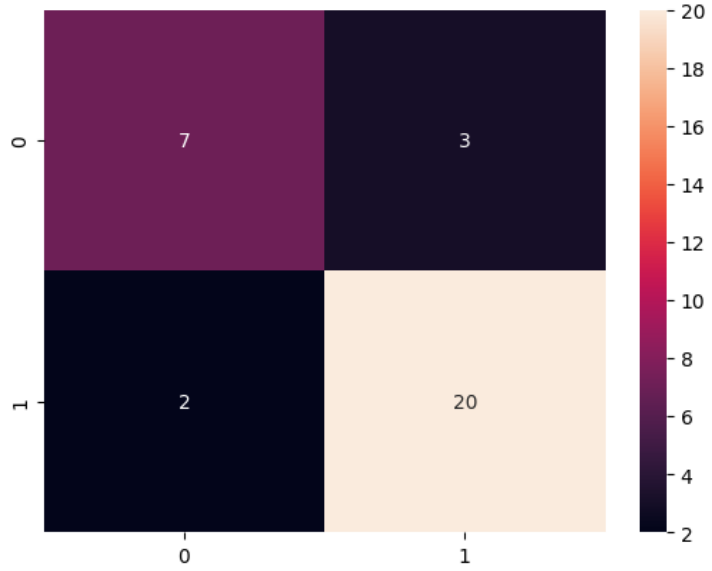
ResNet50 Model Architecture



ResNet50 Model Performance








```
loss_res, acc_res = resnet.evaluate(test_data_iterator)
```

```
20/20 [==============================] - 9s 411ms/step - loss: 0.4883 - accuracy: 0.7644
```

Conclusion

- Accuracy: ResNet50 model achieved a higher accuracy (84.38%) compared to the proposed model (78.12%).
- Precision: Proportion of positive identifications that are correct. ResNet50 model has a higher precision (86.96%) compared to the proposed model (75.86%). ResNet50 is better at avoiding false positives.
- Recall: Proportion of actual positive cases that are correctly identified. The proposed model has a recall of 1 indicating that it identified all actual pneumonia cases in the testing dataset. ResNet50 model has a recall of 90.16% indicating that it missed a few cases.
- F1 Score: Harmonic mean of precision and recall. ResNet50 model has a higher F1 score compared to the proposed model.
- Overall, the ResNet50 model is more balanced across all metrics.

Additional Considerations

- False Positives: Incorrect identification leads to unnecessary medical procedures, causing stress and anxiety for the patient.
- Delayed diagnosis of other conditions: Focusing on the wrong condition can delay the diagnosis and treatment of an actual underlying issue.

- False Negatives: Incorrect identification of a true case, can lead to missed diagnosis and delayed treatment, worsening the patient's condition.
- Risk of spreading contagious diseases: If a test misses an infectious diseases case, it might remain undiagnosed and could spread.

References

- Detection of pneumonia using convolutional neural networks and deep learning: https://www.sciencedirect.com/science/article/pii/S0208521622000742#s0035
- https://medium.com/@kenneth.ca95/a-guide-to-transfer-learning-with-keras-using-resnet50-a81a4a28084b
- https://datagen.tech/guides/computer-vision/resnet-50/