Lung Disease Detection using X-Ray Images using Deep Learning.

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Research paper-Information

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Deep learning-enabled system for rapid pneumothorax screening on chest CT,

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Problem statement

- Pneumothorax is a type of lung infection that requires immediate care and an X-Ray and CT is a recommended for the patient if he has symptoms.
- When chest CT exams cannot be evaluated right away, as may occasionally happen when queues of cases waiting for interpretation build up, timely interpretation can be difficult. Additionally, not all imaging departments have radiologists on-site for coverage 24 hours a day. When chest CTs are finished, a quick system for spotting pneumothorax might be utilized to convey alerts to radiologists and other healthcare professionals, reprioritizing the chest CT work list for cases with pneumothoraces.
- This Approach is useful in developing countries that don’t have experienced Radiologist in detection of pneumothorax.

Data

- To solve this problem we have taken a dataset from Kaggle to solve this problem statement.
- The data is divided into 1600 as 1 (with pneumothorax positive) and 400 as 0 (with pneumothorax negative) values.

- Dataset:Pneumothorax Binary Classification task | Kaggle

Motivation -1

- The main motive of this proposed work is to make predictions more faster and accurate and reduce the patient time in waiting and in results.
- The motivation for doing this project is the detect lung diseases more quickly and connect to the hub to evaluate if positive. The use case of China in covid19. The government of China has installed CT for every Small Health care Center all around the country which provided faster detection of covid compared to regular tests. If we use Deep learning in this scenario it will decrease training people and resources.

Motivation -2

- The project can be used in developing countries such as India, Bangladesh where they have inexperienced radiologists deep learning techniques can help in providing insights to prediction, we could send to the central hub to connect to doctors for evaluation.

Survey paper-1

- A. Sharma, D. Raju, and S. Ranjan, “Detection of pneumonia clouds in chest X-ray using image processing approach,” *2017 Nirma University International Conference on Engineering (NUiCONE)*, 2017, pp. 1-4, doi: 10.1109/NUICONE.2017.8325607.
- “*Detection of pneumonia clouds in chest X-rays uses an image processing approach to detect pneumonia*.” The approach they have followed is images have been resized to the optimal size of computation, then do histogram equalization to enhance the contrast of images, then apply the algorithm to crop the area, calculate the lung boundary, then perform image thresholding to get non-cloudy lung image and when we do ratio between the complete lung and non-cloudy region, we get cloudy or infected path.
- The approach proposed in very intuitive and but CNN models may better perform than this approach. The target paper follows the steps implemented in this paper and includes three more steps to improve the prediction.

Survey paper-2

- E. Ayan and H. M. Ünver, "Diagnosis of Pneumonia from Chest X-Ray Images Using Deep Learning," 2019 Scientific Meeting on Electrical-Electronics & Biomedical Engineering and Computer Science (EBBT), 2019, pp. 1-5, DOI: 10.1109/EBBT.2019.8741582.
- *“Diagnosis of Pneumonia from Chest X-Ray Images Using Deep Learning”* introduced the implementation of two- well-known CNN networks Xception and Vgg16. The first step uses a 1×1 pointwise convolution and follows a 3×3 depth-wise convolution. The Xception architecture has 36 convolutional layers for feature extraction. After a convolutional layer followed by a logistic regression layer.

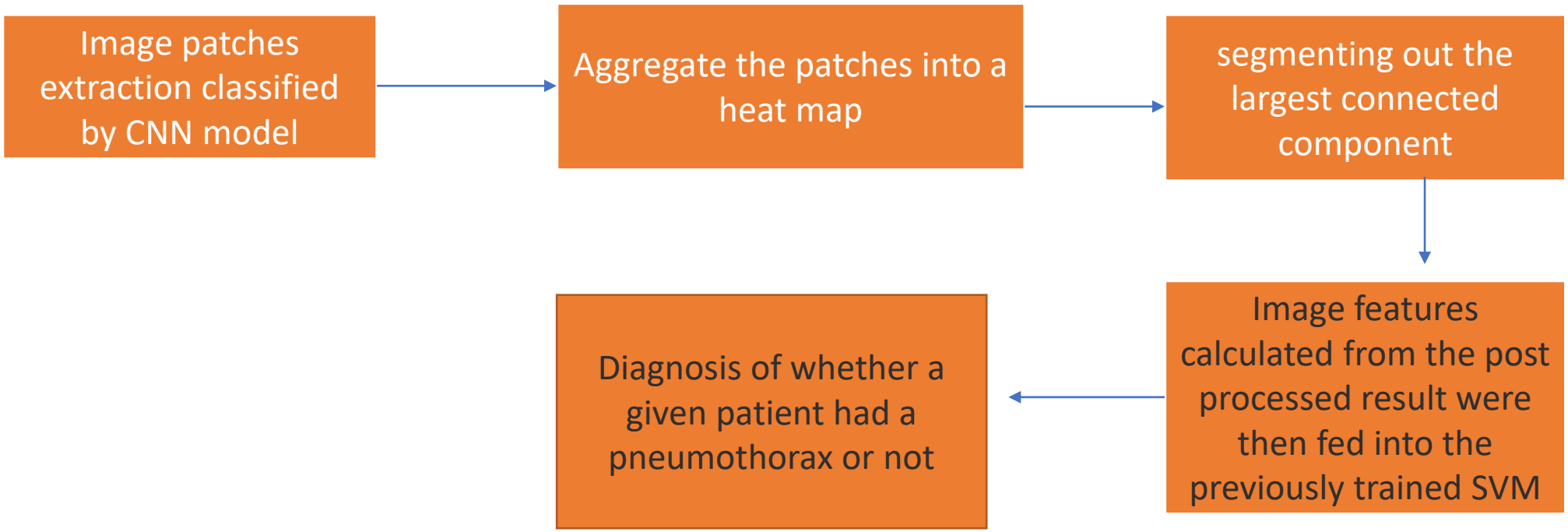
Reason to chose these Papers

- The reason that I have chosen these two papers to be existing models is that I want or target paper will be implementing the methodology of these both existing models and implementing them in one project.
- The first paper "*Detection of pneumonia clouds in chest X-rays uses an image processing approach to detect pneumonia"* uses histogram equalization to contrast images and apply the algorithm to detect the contour and get the result and the second paper uses CNN networks such as Xception and Vgg16 after applying the algorithm we apply logistic regression layer. The target creates 3D heat maps defined to include 1) pneumothorax area size, 2) relative location of the region to the lung boundary, and 3) a shape descriptor based on regional anisotropy. A support vector machine (SVM) was trained for classification.

Summary of the Method

- The main aim of the target paper is to detect Pneumothorax using X-Rays which use the approach of “CNN” and SVM to detect pneumothorax traces using X-rays.
- First, the previously trained CNN identified picture patches collected from each patient in the test set depending on the likelihood of pneumothorax. The outcomes of patch-wise prediction were then combined to create a 3D heat map of the pneumothorax-prone areas. The largest connected component was then segmented out of the heat map using the region-growing method, creating a single region of pneumothorax. The previously trained SVM was then fed the image characteristics derived from the post-processed result, which carried out the prediction (i.e., diagnosis) of whether a certain patient had a pneumothorax or not.

High level view

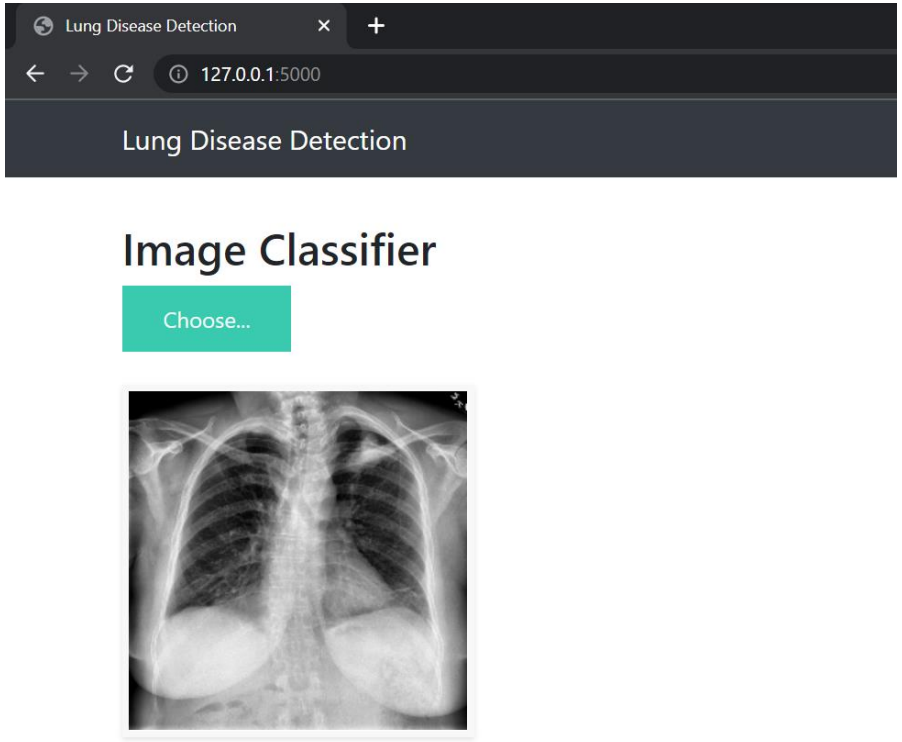


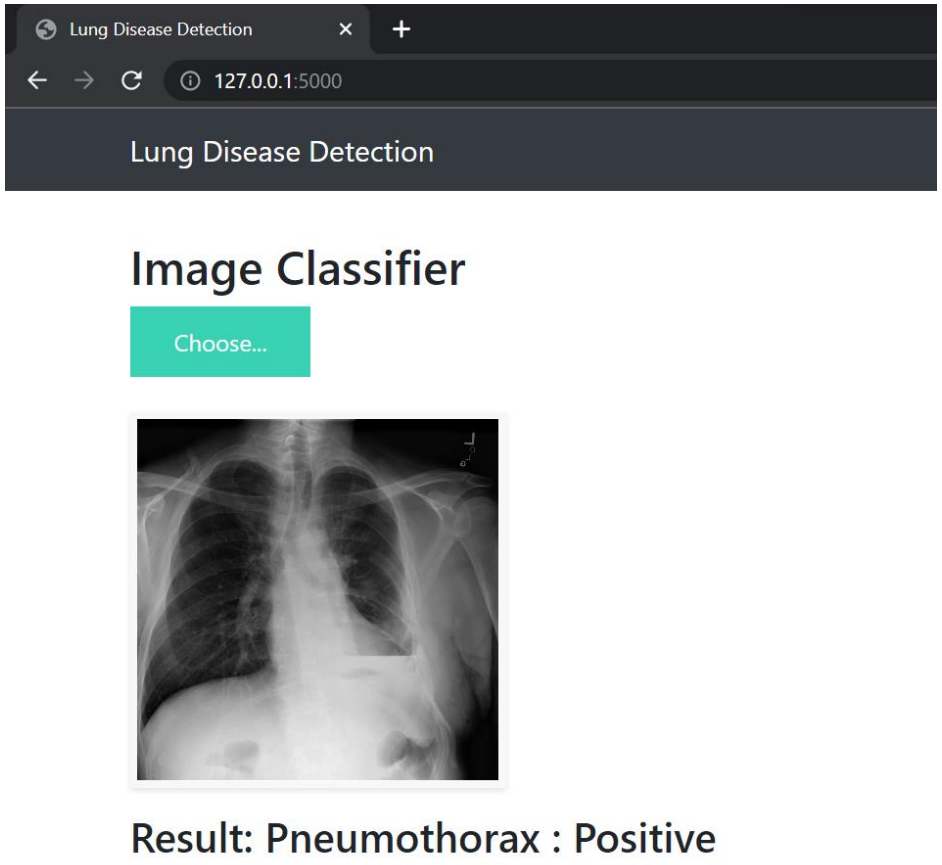
Code

```
model=Sequential()
model.add(Conv2D(filters=16,kernel_size=2,padding="same",activation="relu",input_shape=(224,224,3)))
model.add(MaxPooling2D(pool_size=2))
model.add(Conv2D(filters=32,kernel_size=2,padding="same",activation ="relu"))
model.add(MaxPooling2D(pool_size=2))
model.add(Conv2D(filters=64,kernel_size=2,padding="same",activation="relu"))
model.add(MaxPooling2D(pool_size=2))
model.add(Flatten())
model.add(Dense(500,activation="relu"))
model.add(Dense(2,activation="softmax"))
model.summary()
```

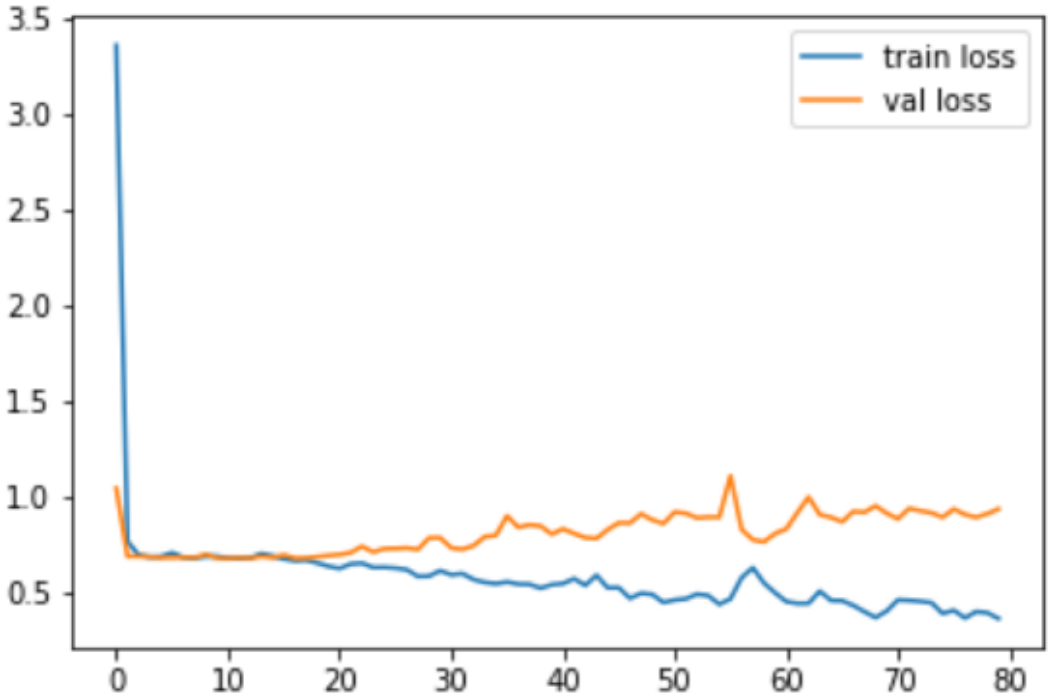
```
r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=80,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

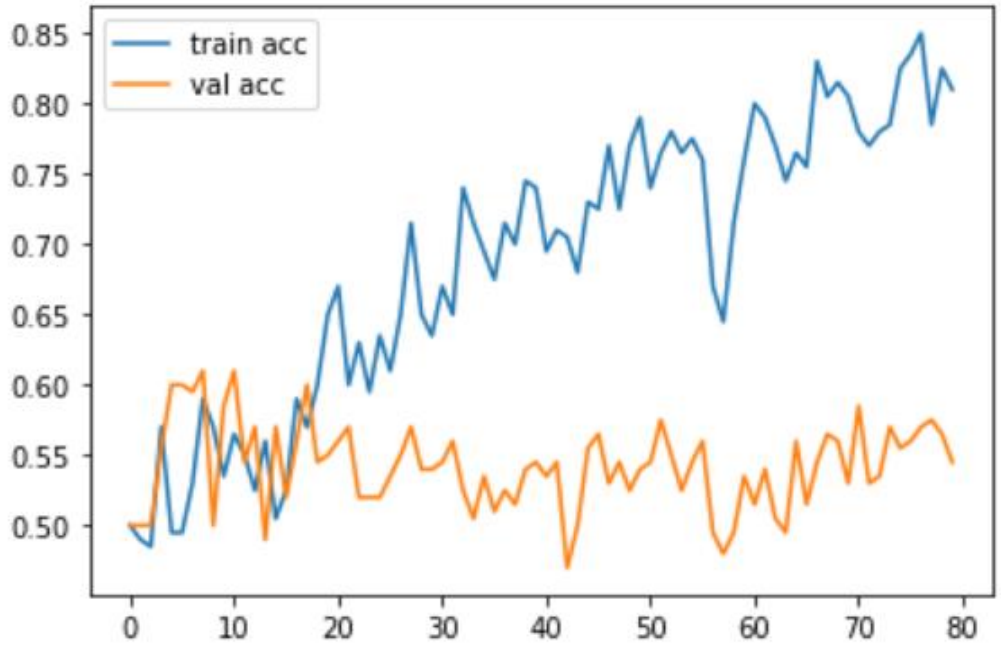
Input and output





LOSS AND ACCURACY





Conclusion

- The Deep Learning Model is performing very well in detecting pneumothorax very well
- The model or the project will help in assisting doctors and radiologists in getting more insights

Future Scope

- Even though our proposed model well on the data, an application of healthcare is more complex to implement in the real world
- More better models which are sophisticated can be used to detect Disease
- The Central dashboard can be developed so that doctors at higher level can view the image and diagnose the problem

Resources

- Target paper: Deep learning-enabled system for rapid pneumothorax screening on chest CT – ScienceDirect
- Two existing papers: Diagnosis of Pneumonia from Chest X-Ray Images Using Deep Learning | IEEE Conference Publication | IEEE Xplore
- Detection of pneumonia clouds in chest X-ray using image processing approach | IEEE Conference Publication | IEEE Xplore
- Data set : Detection of pneumonia clouds in chest X-ray using image processing approach | IEEE Conference Publication | IEEE Xplore

Thank You