Classification of respiratory diseases using Convolutional Neural Network

submitted By

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CSE499B Senior Project Design -II
Section: 12

Submitted To: **Dr. Mohammad Ashrafuzzaman Khan**

1.Problem analysis

What was the Problem

To classify respiratory diseases from a dataset containing 920 audio recordings of breathing sound

Why was it difficult

- Dataset contained both Tabular data and Audio data.
- Difficult to combine both.
- Small Dataset
- Lack of computational power

How did we address those

- We converted audio files to image data (MFCC).
- We fed them as input to our CNN and VGG16 models
- We used Google Colab to handle the computation.

2.Related work

1. *Lung Disease Classification using Deep Convolutional Neural Network*
2. *LungBRN: A Smart Digital Stethoscope for Detecting Respiratory Disease Using bi-ResNet Deep Learning Algorithm*
3. *A Respiratory Sound Database for the Development of Automated Classification*
4. *Deep learning based respiratory sound analysis for detection of COPD*
5. *Convolutional neural networks based efficient approach for classification of lung diseases*

So far Paper 4 had the best accuracy which is 93 %

Data Exploration:

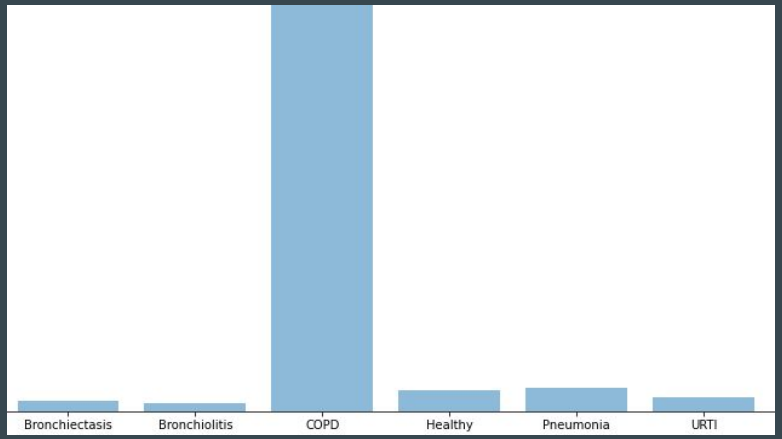

Fig: Disease Count

patient_id	age	sex	adult_bmi	child_weight	child_height
101	3.00	F	NaN	19.0	99.0
102	0.75	F	NaN	9.8	73.0
103	70.00	F	33.00	NaN	NaN
104	70.00	F	28.47	NaN	NaN
105	7.00	F	NaN	32.0	135.0
106	73.00	F	21.00	NaN	NaN

Fig: Demographic Table

ratory_cycle	End_of_respiratory_cycle	Presence/absence_of_crackles	Presence/absence_of_wheezes
1.330	3.804	0	0
3.804	6.396	0	0
6.396	8.938	1	0
8.938	11.580	1	0
11.580	14.072	1	0
14.072	17.049	1	0

Fig: Audio File Annotation

Pre-Processing:

- Feature Extraction and conversion of audio file to spectrogram and MFCC

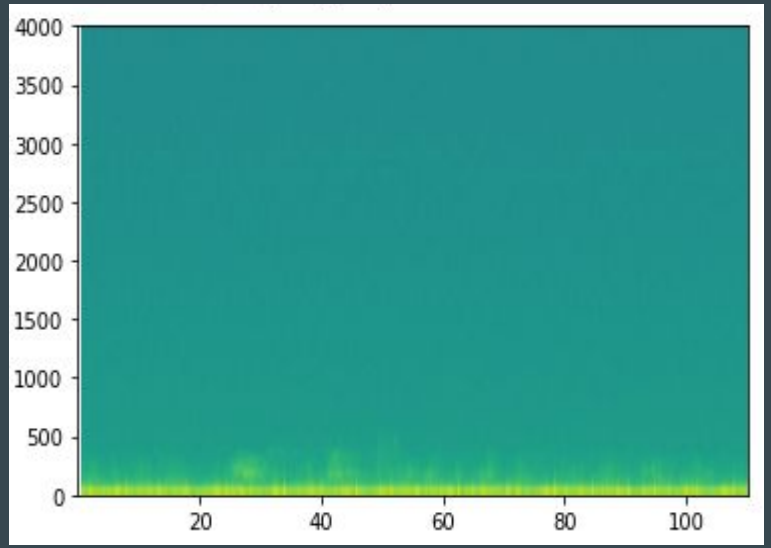

Fig: Audio Spectrogram

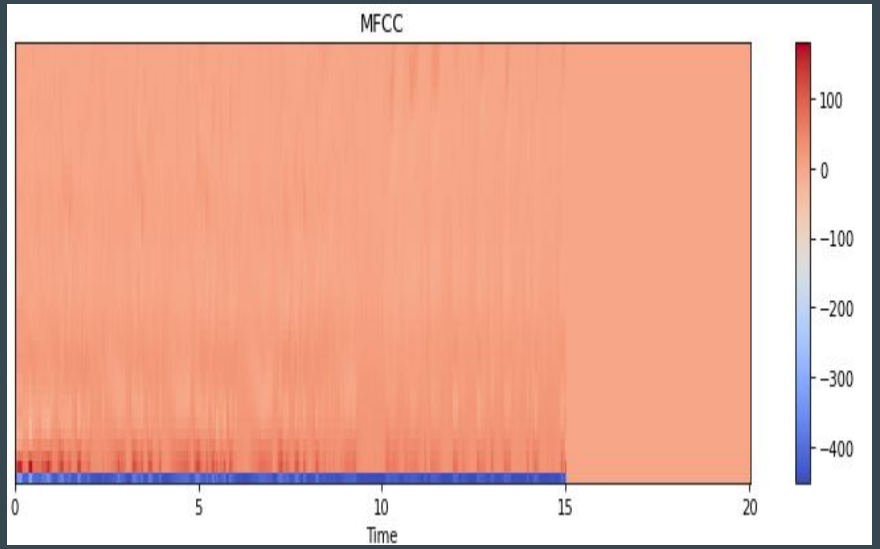

Fig: MFCC (Mel-frequency cepstrum)

- Removing least frequent diseases for better distribution.

```
# delete the very rare diseases
features1 = np.delete(features, np.where((labels == 'Asthma') | (labels == 'LRTI'))[0], axis=0)

labels1 = np.delete(labels, np.where((labels == 'Asthma') | (labels == 'LRTI'))[0], axis=0)
```

Models Used:

- Convolutional Neural Network, VGG16 and ResNET

Work Distribution:

- Jushraf Rahman : Mostly in charge of the coding
  Pre-Processing and Model construction of CNN
  Implemented VGG16 model

- Mir Sadia Afrin : Mostly in charge of the documentation
  Training and Testing of CNN model
  Attempted ResNET50 model

5. Tools

- TensorFlow, Librosa, Keras, scikit-learn, Numpy, Pandas
- Google Colab
- Jupyter Notebook
- Kaggle
- Google Scholar
- Youtube Sources

4. Unique/original part of the project

- Areas where there is lack of skilled medical staff , a sound classification using our model can provide immediate diagnostic reports.
- Help the medically under-served population
- Our model aims to improve the existing architecture by providing better accuracy

6. Project Design:

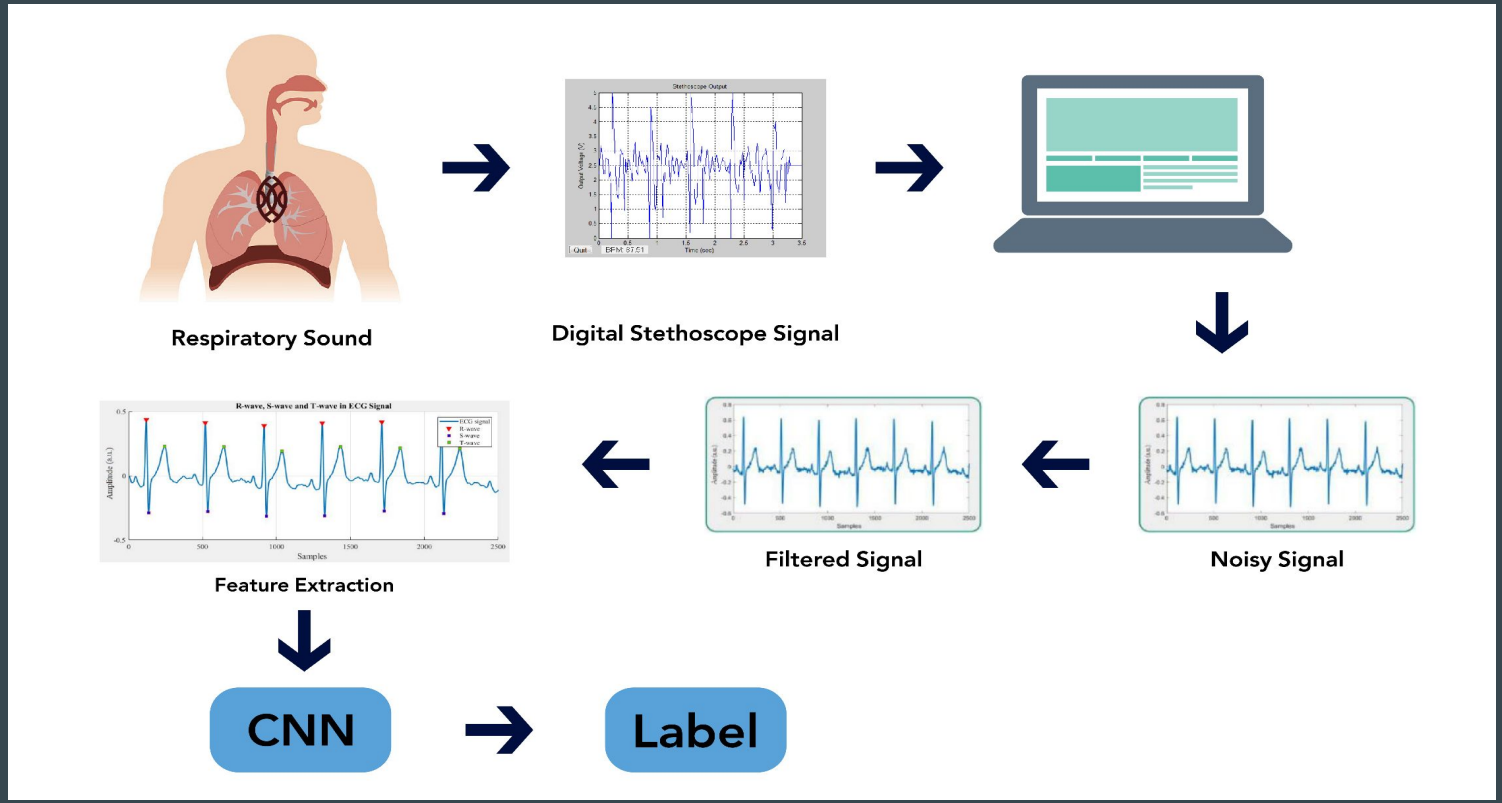

Fig: Overall Workflow

7. Result Analysis:

CNN : **After full completion of 250 epochs**

Training Accuracy : 92 . 9% **Testing Accuracy : 86 . 95 %**

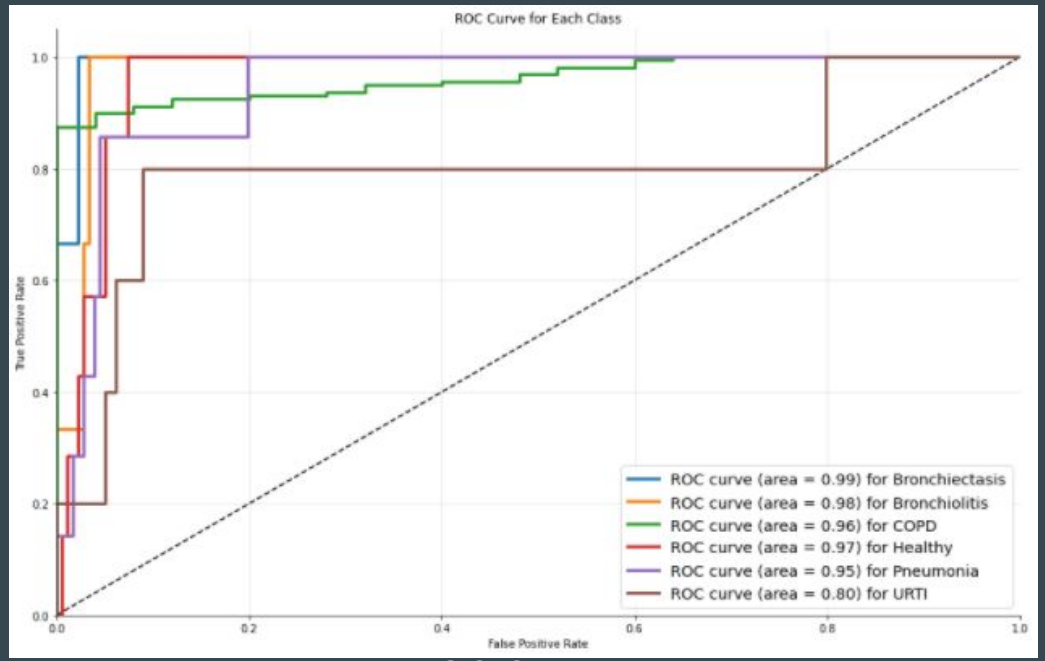

Fig: ROC Curve

7. Result Analysis:

VGG16 : Completed only **2/100 epochs**. Per epoch took approximately **4 hours** time.

Training Accuracy : **83 . 71 %**