COVID-19 Detection using Audio Spectral Features and Machine Learning

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SenSIP INDUSTRY CONSORTIUM

MOTIVATION

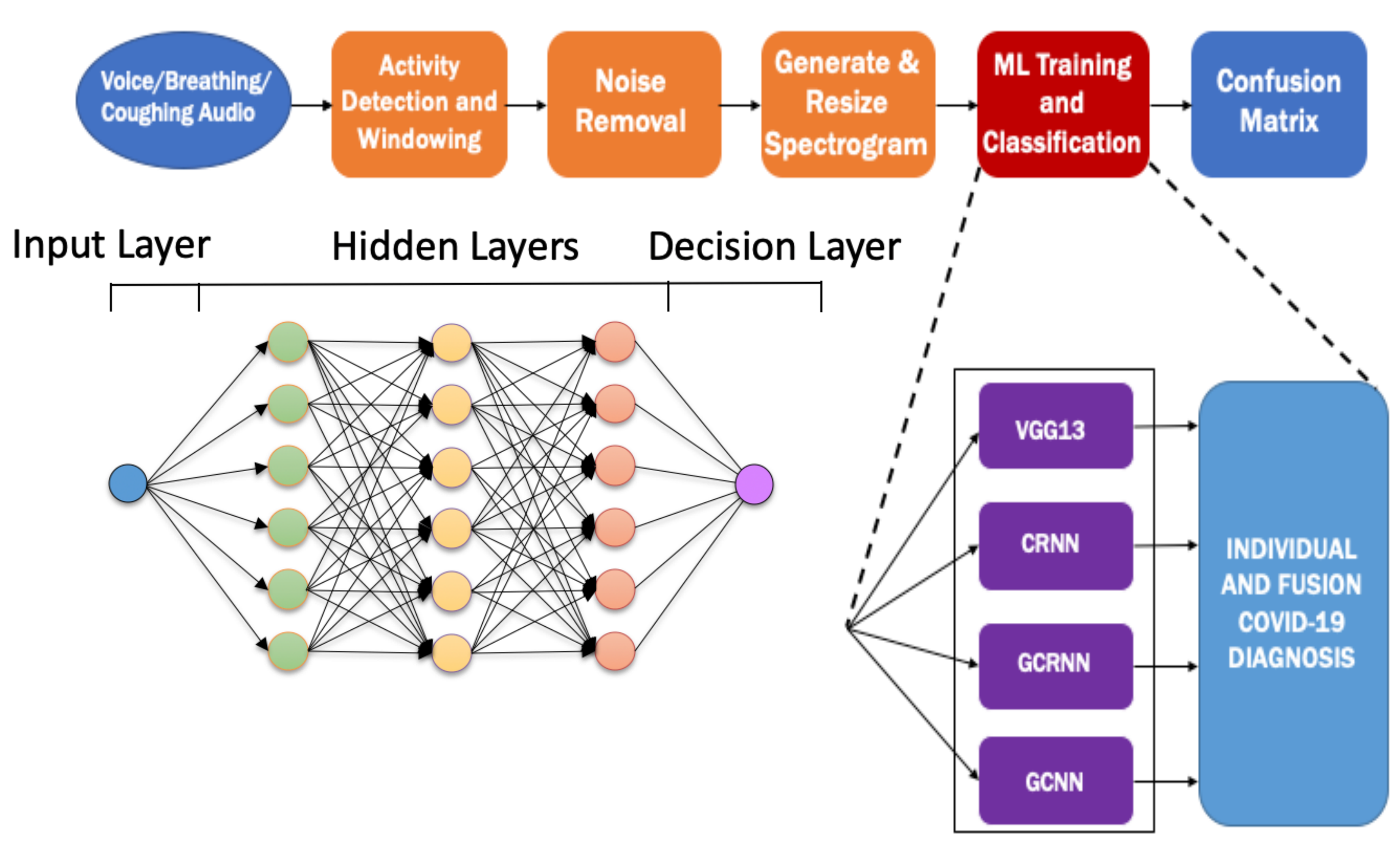
COVID-19 Rapid Testing is needed in order to control the pandemic.

- **Shortcomings of conventional testing:**
  - **Limited availability**
  - **Results can take long to obtain**
- **Machine learning can be used to detect COVID-19 using audio samples**

PROJECT AIM

- **Create a robust algorithm for detecting COVID-19 using only audio samples.**
- **Simulate algorithm and obtain results**
- **Deploy the algorithm in a smartphone app for widespread accessibility**

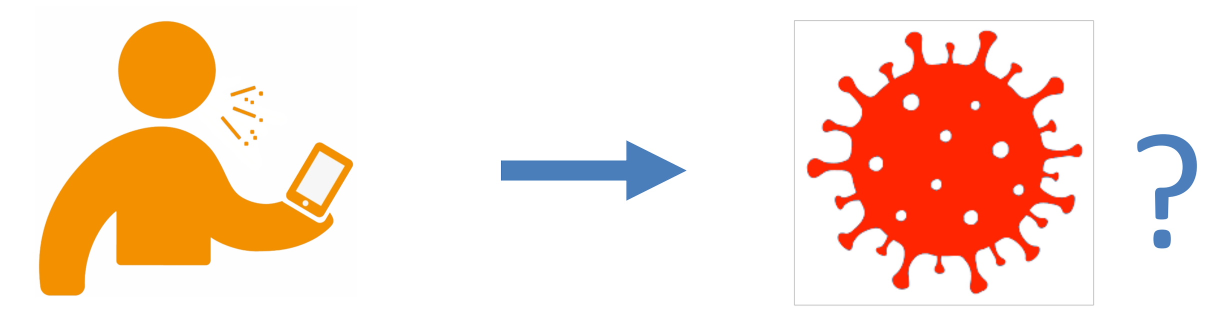
COVID-19 DETECTION ALGORITHM



DATA COLLECTION AND ALGORITHMS

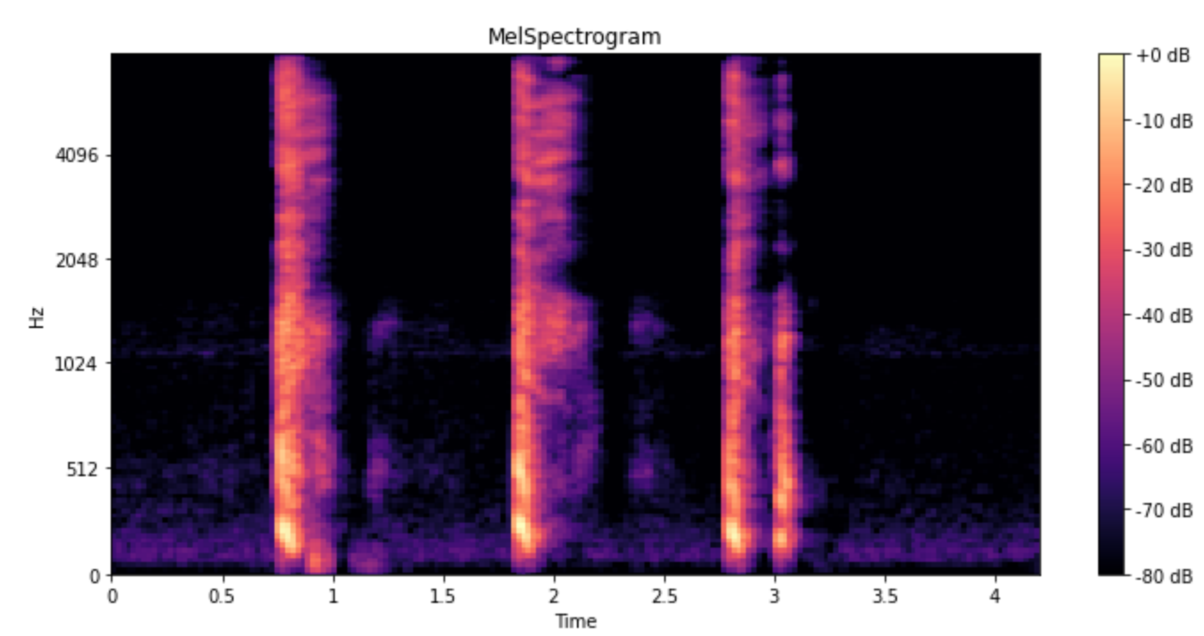
- **Data Collection: Use of Coswara [1] and COUGHVID [2], public datasets containing internationally crowdsourced audio data**
- **Algorithms: Visual Geometry Group 13 (VGG13) [3], Convolutional Recurrent Neural Network (CRNN) [4], Gated Convolutional Neural Network (GCNN) [5], Gated Convolutional Recurrent Neural Network (GCRNN) [6], and fusion method [7].**

MOBILE PHONE SOLUTION



SPECTROGRAM OF COUGHING PATTERNS

- **Spectrogram features capturing cough patterns**
- **Images Converted and passed to Neural Net**
- **Other Spectral Features and ML Algorithms considered [8, 9]**
- **NN Trained using Mel spectrograms generated from Coswara [1] and COUGHVID [2] data.**



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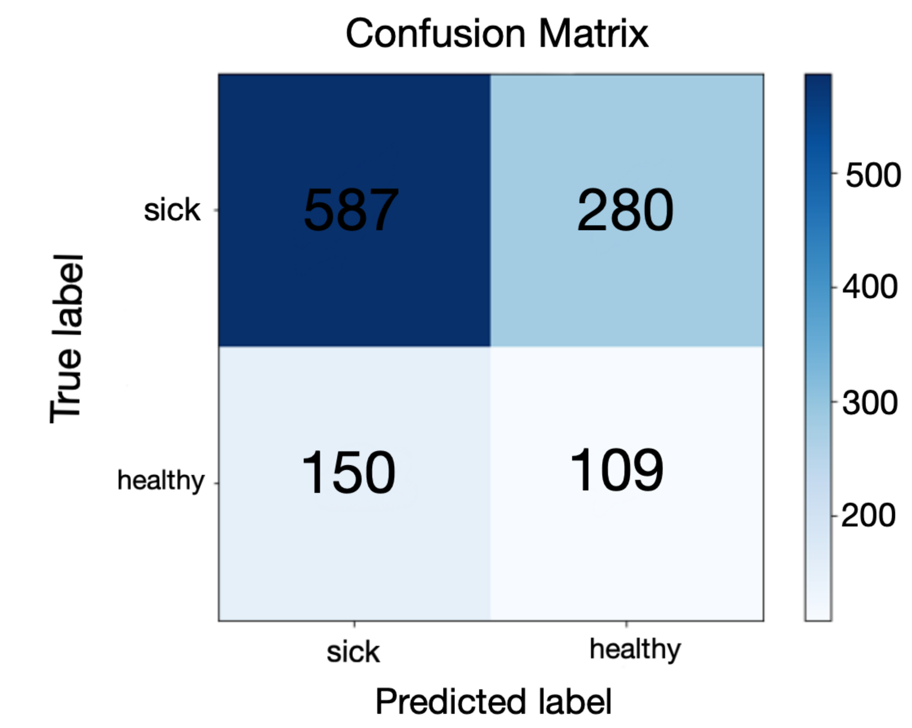
PRELIMINARY RESULTS

Developed Python Implementation

```
import features

# Use a logmel representation for feature extraction
extractor = features.LogmelExtractor(cfg.sample_rate,
                                     cfg.n_window,
                                     cfg.hop_length,
                                     cfg.n_mels,
                                     )
```

Class	MAP@1	F-score	Precision	Recall
COVID-19	0.320	0.292	0.268	0.320
healthy	0.738	0.761	0.784	0.738
Macro Average	0.529	0.526	0.526	0.529
Micro Average	0.642	0.642	0.642	0.642



accuracy=0.6181; misclass=0.3819

CONCLUSION

- **Feasibility of method demonstrated**
- **Initial results are encouraging:**
  - **61.81% accuracy with REU algorithm (more recent results in SenSIP at 80%)**
- **9M-22M parameters per model**
- **Training requires high speed computing**

ONGOING & PLANNED WORK

- **Detect COVID-19 with 80% or more sensitivity with high specificity.**
- **Develop software for use on smartphones**
- **Explore the use of additional features for classification**
- **Paper invited to IEEE Asilomar Conference**
- **Obtain additional classification results using DiCOVA dataset and revised algorithms [10]**
- **Method to be applied to detect other breathing abnormalities**

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