Early detection of respiratory diseases caused by COVID-19 and integration into tele-health service via speech, voice and cough analysis software

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OBJECTIVE: This project aims to early detect COVID-19 related upper respiratory diseases using speech, voice, and cough analyses.

MATERIAL and METHODS: The speech, voice, and cough analysis recordings were made with a standard cell phone placed at a standard distance and a pop-up filter. Thus, sounds were analyzed to recognize classifying features by recording patients reading a standard text, coughing, and observing cough counts. The overall architecture of the system consisted of two main stages, which were feature extraction and model training. Considering the size of our newly created dataset, we made use of a feature-based and shallow model for learning. In the study, we employed two sets of features for the extraction: Due to its success in speech recognition, the Mel Frequency Cepstral Coefficients (MFCCs) was selected as the handcrafted feature. In addition to the handcrafted feature, we also employed the VGGish pre-trained neural network feature in the transfer learning context for the analyses. For the model training, the Support Vector Machine - SVM algorithm was used to learn from the MFCC and VGGish features.

RESULT: The recorded sounds collected from 25 COVID-19 positive and 25 COVID-19 negative patients were pre-processed by separating speech and coughs and transformed into 100 labeled data. The dispersion of the features (MFCC and VGGish) extracted from digital cough and speech records were observed and compared for these two groups (Figure 1-2). The designed SVM classifiers were trained separately with the MFCC and VGGish features, and the outputs were contrasted. Based on the experiments, the highest classification performance was obtained for the VGGish feature representation and speech with an accuracy rate of 0.86. Our results showed that VGGish features better represent the speech and the MFCC features better represent the coughs. (Figure 3)

CONCLUSION: Sound analyses showed a connection between the speech and cough records with COVID-19 and are critical in detecting COVID-19 cases.

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Keywords: COVID-19, Machine Learning, Mel-Frequency Cepstral Coefficients (MFCC), VGGish, Biologic Disaster

Figure-1

Box plots for MFCC and VGGish attributes. CCP: Cough COVID Positive, CCN: Cough COVID Negative, SCP: Speech COVID Positive, SCN: Speech COVID Negative
**Figure-2**

Spectrum analysis. SN: Speech Negative, SP: Speech Positive

**Figure-3**

Mel-spectrogram analysis. SN: Speech Negative, SP: Speech Positive

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**Detaylar**

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