COVID-19 PATIENT DETECTION FROM TELEPHONE QUALITY SPEECH DATA

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ABSTRACT

In this paper, we try to investigate the presence of cues about the COVID-19 disease in the speech data. We use an approach that is similar to speaker recognition. Each sentence is represented as super vectors of short term Mel filter bank features for each phoneme. These features are used to learn a two-class classifier to separate the COVID-19 speech from normal. Experiments on a small dataset collected from YouTube videos show that an SVM classifier on this dataset is able to achieve an accuracy of 88.6% and an F1-Score of 92.7%. Further investigation reveals that some phone classes, such as nasals, stops, and mid vowels can distinguish the two classes better than the others.

Index Terms— COVID-19, Telephone speech, super vectors, SVM

1. INTRODUCTION

The pandemic, due to the novel coronavirus (COVID-19), has spread around the world. In such a situation, the identification of people infected with COVID-19 is challenging for health organizations as well as individuals. Major symptoms such as a rise in body temperature, cough, difficulty in breathing are observed; however, totally asymptomatic cases are also possible[1]. The clinical protocols in identifying whether the individual is infected with coronavirus include swab test [2], CT scans [3], chest X-Ray Images [4] etc. In this context, leveraging bio-markers like speech and audio signals in screening the COVID-19 will help in the assessment of the viral infection. Different studies and pathological investigations have proved that COVID-19 infected individuals exhibit difficulty while breathing and speaking. Furthermore, the changes in speech might not be identifiable by human perception, although the person is infected, but the Computer auditions (CA) [5, 6] can. As a token of contribution to the society in this pandemic situation, we tried to investigate on detection of the COVID-19 infection from speech sounds alone. In this process, we also focus on telephone speech so that such a system could be integrated to assess the risk of the pandemic at a region by telephone operators.

There are a few attempts in the literature in identifying pathological conditions such as bronchitis and pertussis using mainly cough patterns [7]. These research efforts perform machine learning techniques on speech samples collected from smartphone recordings. From the studies on the COVID-19 patients, it was noticed that the respiration activity would be more rapid for the infected people than other patients with flu and common cold [8]. Other studies show that the respiratory parameters are also have impact on the persons mood/emotion[9], stress levels [10] and physiological state of individuals [11]. In the context of the Interspeech Computational Paralinguistics Challenge (ComParE), different research efforts have attempted to estimate the behavioral state of humans using speech data in conditions like cold, cough, pain, sleepiness, and infant cries. Schuller et al. has suggested a set of computer audition tasks using speech analysis and sound analysis for COVID-19 risk assessment using machine learning techniques [6]. However, in this work, we look only at the speech signal and not at breathing or cough patterns that may be difficult to acquire through a noisy telephone channel. Also, in this case, the user of the system does not have to force a cough or create breathing patterns. To the best of the authors' knowledge, this is the first work on COVID-19 screening using only telephone quality speech data.

The organization of the paper is as follows, Section 2 details the feature extraction and statistical representation of each phoneme as well as sentence. It also details the classification methods. In Section 3, the details of the collected dataset are briefed. Later the experiments and results are detailed in Section 4. Finally, the conclusions of the reported work and future directions of the proposed approach are presented in Section 5.

2. APPROACH

Many attempts have been made to automate the disease identification using the respiratory patterns [8], cough patterns [7] and also COVID-19 [5]. These attempts make use of the biomarkers from speech such as fundamental frequency, short-term cepstrum, cepstral peak prominence, Harmonics to noise ratio, Glottal open quotient, etc. Higher-level feature derived features from such features were employed to screen the people for COVID-19 [5]. In another attempt, a pool of such features across different sounds was used to identify the pres-