

# Summary:

## Research Proposal SPIRA Study: Early Detection System for Respiratory Failure through Audio Analysis

Coordinator: Marcelo Finger (DCC-IME-USP)

Computer Science Department

Institute of Mathematics and Statistics

University of São Paulo

### Summary

The aim of this project is to develop a tool that can perform an early detection of subjects with respiratory insufficiency due to COVID-19 using speech audio data. For this, audio records of infected people, as well as normal people, was collected recording differences associated with  $O_2$ -saturation and respiratory rate that allowed the two groups to be distinguished. The proposed automatic classification tool will be based on artificial intelligence techniques, signal processing and machine learning. Initially the tool it will help screening patients who need to seek medical-hospital assistance. In a second phase, the tool can help remote medicine systems to continuously monitor patients, allowing the follow-up of the evolution of hospitalized patients.

**Related Project:** Artificial Intelligence Center (C4AI), Engineering Research Center of Fapesp-IBM Proc.: 2019/07665-4.

### Motivation

The COVID-19 pandemic has placed most of the population of the major cities of Brazil in isolation, the so-called social distancing. Large agglomerations of people can facilitate the spread of the virus, and this is particularly worrisome in the case of agglomerations in hospitals and health centers. In this case, the sorting process should be efficient and, if possible, remote.

It is essential to prevent people that with minor or misleading symptoms that may not justify hospitalization from being exposed to the virus. On the other hand, hospital patient screening systems are overloaded with people with minor symptoms, due to the large influx of people seeking clarification about their health situation. Even if these patients received consultation by telemedicine, they could rapidly evolve into respiratory insufficiency. Monitoring the patient remotely, frequently and automatically is the best way to combine respect for social distancing and patient safety. An automatic system for early detection of pulmonary infection through remote audio analysis comes to both meet the interests of the population and relieve the burden of the medical screening and health infrastructure service.

# Objectives

This proposal aims to develop a remote audio processing system to classify speakers in two categories: those who should/should not be hospitalized. This system will employ modern techniques of artificial intelligence, audio processing, automatic learning and deep learning. For this, the following steps must be accomplished.

1. Creation of a database of audios containing speech records of both hospitalized patients due to COVID-19 and healthy people who did not need hospitalization.
  - a. Collection of audio data and other information from COVID-19 patients, preferably done by health professional in hospitals (covidário).
  - b. Data collection from asymptomatic people or people with symptoms that do not require hospitalization. (sugiro adicionar – que foi coletado via Plataforma)
2. Development of artificial intelligence algorithms and audio processing necessary for the training and execution of classifier that will screen patient audios.
3. Implantation of an automatic audio system based on support audio classifier to support the patient screening system.

## Scenario of possible use of an automatic classifier

We present a possible scenario for the use of an automatic classifier, in which the automated tool is not the final decision maker of the hospitalization decision. Consider an interface implemented through a communication application, such as WhatsApp, which can interact with the general public.

A user presenting some symptoms starts an interaction session with the application, answering questions such as age and symptoms, and at the end the user records an audio clip uttering a sentence that forces breathing several times during the recording. If the voice emission does not indicate the need for hospitalization, a message could be sent to the user informing him to wait for the symptoms to progress and to contact the system again a few hours later. If the audio indicates the need for the user's hospitalization, a double alarm could be issued.

The first recipient of the alarm is a healthcare professional responsible for screening patients, who will be advised that they should contact the patient who presents signs compatible with the need for hospitalization. The second recipient is the patient himself, who will be advised that he must wait for a contact from a health professional soon.

Due to the possibility of the system generating both false positives and false negatives, the issuing of an alarm should not be the only indication of hospitalization, but rather the judgment of a health professional based on the patient's data (symptoms, audio recording and automatic classification) of the system). Similarly, even without the alarm, the health professional must maintain autonomy to decide on hospitalization, even if the system has not considered that the patient requires hospitalization.