

UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Detecting Symptoms of Chronic Obstructive Pulmonary Disease and Congestive Heart Failure via Cough and Wheezing Sounds Using Smart-Phones and Machine Learning

by
Anthony Windmon

For the Ph.D. degree in Computer Science and Engineering

Chronic Obstructive Pulmonary Disease (COPD) and Congestive Heart Failure (CHF) are progressive disorders, and major health concerns among today's aging population. COPD causes a large mucus buildup in the lungs, leading to chronic cough and difficulty breathing. CHF causes fluid buildup in the lower lungs due to the failing heart, causing cough and difficulty breathing. People who are clinically diagnosed with COPD or CHF are expected to regularly monitor their symptoms and follow complex recommendations in an effort to prevent exacerbation. In this dissertation, we design machine learning techniques for early signs of exacerbation of COPD or CHF symptom by detecting worsening cough and wheezing. First, we present the feasibility of leveraging chronic cough samples, recorded using a smart-phone's microphone, and processing the audio samples via machine learning algorithms, to differentiate COPD from normal (non-COPD) cough patterns. Next, we propose TussisWatch, a smart-phone system to identify cough episodes as early symptoms of COPD or CHF. TussisWatch consists of a two-level, Random Forest classification scheme. Lastly, we consider proper inhaler use among COPD patients, to evaluate the effectiveness of the inhaler in relation to the severity of their symptoms. In all techniques, we extracted commonly used audio features, and achieved good system performances based on several metrics: Precision, Recall, F1-Scores, Specificity, and Sensitivity. We believe that our proposed systems have the potential to aid early access to healthcare, educate patients on clinically proven self-care practices that they can perform at-home and reduce the rates of re-hospitalization caused by COPD exacerbation.

Examining Committee

Ashwin B. Parthasarathy, Ph.D., Chairperson
Sriram Chellappan, Ph.D., Major Professor
Ponrathi R. Athilingam, Ph.D.
Kenneth Christensen, Ph.D.
Alfredo Weitzenfeld, Ph.D.
Tansel Yucelen, Ph.D.

Monday – June 15, 2020
10:00AM
Online (Blackboard Collaborate)
Email awindmon@usf.edu
for more information
THE PUBLIC IS INVITED

Publications

- 1) **Anthony Windmon**, Mona Minakshi, Sriram Chellappan, Ponrathi Athilingam, Marcia Johansson, and Bradlee A. Jenkins. "On Detecting Chronic Obstructive Pulmonary Disease (COPD) Cough using Audio Signals Recorded from Smart-Phones." In HEALTHINF, pp. 329-338. 2018.
- 2) **Anthony Windmon**, Mona Minakshi, Pratoool Bharti, Sriram Chellappan, Marcia Johansson, Bradlee A. Jenkins, and Ponrathi R. Athilingam. "TussisWatch: A Smart-Phone System to Identify Cough Episodes as Early Symptoms of Chronic Obstructive Pulmonary Disease and Congestive Heart Failure." IEEE journal of biomedical and health informatics vol. 23, no. 4 (2018): 1566-1573.
- 3) **Anthony Windmon**, Sriram Chellappan and Ponrathi R. Athilingam, "Evaluating the Effectiveness of Inhaler Use Among COPD Patients via Recording and Processing Cough and Breath Sounds from Smartphones (Submitted to EAI MobiCASE 2020 – 11th EAI International Conference on Mobile Computing, Applications and Services).

Robert Bishop, Ph.D.
Dean, College of Engineering

Dwayne Smith, Ph.D.
Dean, Office of Graduate Studies

Disability Accommodations:

If you require a reasonable accommodation to participate, please contact the Office of Diversity & Equal Opportunity at 813-974-4373 at least five (5) working days prior to the event.