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

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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 smartphone’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 smartphone 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.

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The public is invited

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