Project – Cough Detection

Asthma, a chronic disease involving the airways and the lungs, ranks among the most prevalent noncommunicable diseases. It is estimated to affect 334 million people worldwide [1]. Thirty million children and adults (less than 45 years old) suffer from it in Europe [2]. According to clinical guidelines, asthma control, a term used to describe the course of the disease, can be assessed by symptoms such as wheezing, breathlessness, chest tightness and coughing. Coughing, particularly the amount of coughs per day or per night, is reported to provide an objective assessment which correlates with the standard measure of asthma control [3].

In addition to being used as a measure of asthma control, coughing, a common symptom for many respiratory diseases, is a well-recognized indicator for the improvement of diagnostics. As a consequence, many efforts have been made towards the development of objective audio cough monitoring systems, which can be traced all the way back to the 1950s [4]. Recent advances have been accomplished by employing machine learning to automatically detect coughs into a semi-automated [5] or fully automated procedure [6]. The latter is a smartphone-based solution that merely makes use of a smartphone's built-in microphone to record coughing sounds and to subsequently detect and count personal coughs.

In order to investigate the feasibility and enhance mobile phone based cough detection, this project focus on detecting *voluntary* coughs from mobile audio recordings.

Data Set

Subject demographics and dataset		
# Subjects	47	33 female, 14 male
Age range	18 - 45	$\mu = 26$, $\sigma = 6$
Voluntary coughs per subject*	20	
Recording devices	Rode Studio Microphone, Nexus 7 Tablet, HTC M8, Samsung S6, IPhone 4	
Control sounds	Induced laughter, speech, throat clearing	

*Cough sounds were recorded at two different distances (0, 1m away)

The data was collected during the following study: "Feasibility Study for the Design of a Novel Biofeedback-based Breathing Training".

Baseline Method

As a baseline method, I would suggest the approach as described in [6], i.e. employing Random Forests for classification and using spectrograms as features. Subsequently, as a first step we could try to employ Convolution Neural Networks in order to enhance the approach and improve the baseline results. Data augmentation techniques may be considered in a later stage of the project.

References

[1] World Health Organization *World Health Organization. Asthma. Geneva, Switzerland*. City, 2013.
[2] Gibson, G., Loddenkemper, R., Sibille, Y. and Lundbäck, B. *The European lung white book*. European Respiratory Society, 2013.
[3] Marsden, P. A., Satia, I., Ibrahim, B., Woodcock, A., Yates, L., Donnelly, I., Jolly, L., Thomson, N. C., Fowler, S. J. and Smith, J. A. Objective Cough Frequency, Airway Inflammation and Disease Control in Asthma. *Chest* (2016).
[4] Bickerman, H. A. and Itkin, S. E. The effect of a new bronchodilator aerosol on the air flow dynamics of the maximal voluntary cough of patients with bronchial asthma and pulmonary emphysema. *Journal of chronic diseases*, 8, 5 (1958), 629-636.
[5] Birring, S., Fleming, T., Matos, S., Raj, A., Evans, D. and Pavord, I. The Leicester Cough Monitor: preliminary validation of an automated cough detection system in chronic cough. *European Respiratory Journal*, 31, 5 (2008), 1013-1018.
[6] Larson, E. C., Lee, T., Liu, S., Rosenfeld, M. and Patel, S. N. *Accurate and privacy preserving cough sensing using a low-cost microphone*. ACM, City, 2011.