INTERNET OF THINGS MEETS COMPLEX NETWORKS FOR EARLY PREDICTION AND MANAGEMENT OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Goal of the project

To address the problem of COPD (Chronic Obstructive Pulmonary Disease) management in a big population of individuals, using a personalized medicine approach that relies on big data gathering and modeling, according to the complex network paradigm. Our scope is to demonstrate a solution that consists of a mobile and cloud computing integrated system for COPD early detection, monitoring, and management.

Short description of the project

COPD is defined as the irreversible clinical condition which reduces pulmonary capacity; if diagnosed in an early phase, its evolution can be controlled. Unfortunately, the early detection of COPD is a difficult task. Capitalizing on recent research results which indicate the Internet of Things solutions as useful in monitoring and managing respiratory disorders, we propose a prototype system for early detection and evolution prediction of COPD. As such, we build a sensor network that gathers multiple physiological signals, and a mobile application that extracts the multi-fractal spectra as signal signatures. Then, the mobile system integrates the physiologic signatures with individual clinical data. On the server side, we collect the integrated data from a population of individuals, to build a complex network model of patients. To this end, we employ modularity clustering and network layout tools to build prediction models for both early detection and evolution prediction of COPD. The prediction model is instantiated as a smartphone application and tested to assess its predictive capacity.

Project implemented by

The research group lead by Mihai Udrescu and affiliated to Advanced Computing Systems and Architectures Lab, Politehnica University Timișoara, and the Pulmonology Research Group from "Victor Babeș" University of Medicine and Pharmacy lead by Ștefan Mihăicuță.

Implementation period

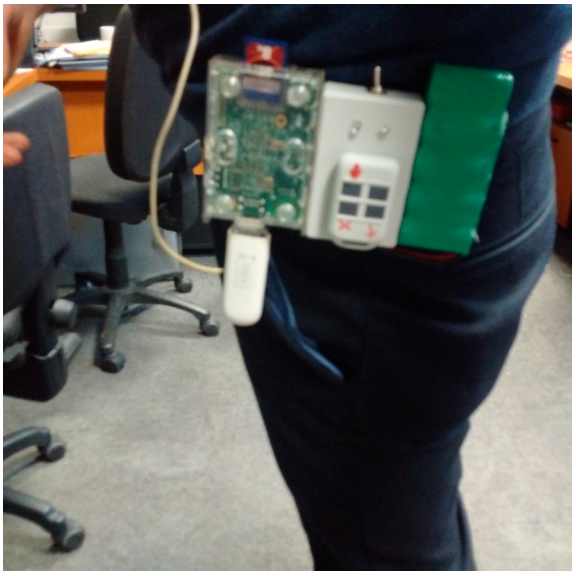
3.01.2017 – 30.06.2018

Main activities

Designing and implementing the mobile software that records anthropometric and clinical data, building a prototype sensor network for collecting physiological signals, implementing the software for multifractal analysis of gathered physiological signals, finding correlations between parameters and data using a complex network model, implementing a software COPD-stage predictor based on the physiological signals.

Results

1. Methodology for processing medical data based on complex network analysis, which allows for identification of clinically-relevant patient phenotypes. The proposed methodology is published in: Mihaicuta, S., Udrescu, M., Topirceanu, A., & Udrescu, L. (2017). Network science meets respiratory medicine for OSAS phenotyping and severity prediction. PeerJ, 5, e3289.
2. Experimental hardware/software platform for gathering and integrating anthropometric, clinical data with physiological signals from COPD patients.



Research centre

Research Center in Computing and Information Technology (CCCTI)

Research team

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Applicability and transferability of the results

Active diagnosis and monitoring systems using a wearable sensor network with application in monitoring respiratory disorders.

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