ANALYSIS, MODELLING AND SENSING OF BOTH PHYSIOLOGICAL AND ENVIRONMENTAL FACTORS FOR THE CUSTOMIZED AND PREDICTIVE SELF-MANAGEMENT OF ASTHMA

Konstantinos Votis#, Aris S. Lalos*, Konstantinos Moustakas*, Dimitrios Tzovaras#

* Electrical and Computer Engineering, University of Patras, Patra, Greece

Centre of Research and Technology, Thessaloniki, Greece

{aris.lalos, moustakas}@ece.upatras.gr, {kvotis,tzovaras}@iti.gr

Introduction

Asthma is a life-long chronic inflammatory disease of the airways that is very common worldwide, affecting people of all ages, race and gender [1]. The knowledge and understanding on what triggers an asthma attack and how this triggers can be avoided are critical features for maintaining a good quality of life [2]. As a result, it is important to provide mHealth personalized asthma monitoring services empowering and guiding patients with asthma to manage their own health. To this end, a novel architecture consisting of an ergonomic, compact and efficient sensor-based inhaler device that communicates with a mobile device is proposed. This personal mHealth guidance system can empower patients with asthma to optimize their treatment towards personalized preset goals and guidelines (healthy lifestyle, exercise, dietary habits).

Proposed architecture

From a high-level architectural point of view, the target system is presented in fig. 1. It consist of three layers: i) the Wireless Body Area Network (WBAN) including all the integrated sensors for data collection of the individuals' health status and behavioural/ environmental activities ii) the application layer consisting of the Mobile Device and a healthcare unit (e.g., cloud-based remote server) where processing of all patients' data is carried out in order to improve the understanding of asthma triggers iii) the knowledge layer that provides support for storing annotated semantic descriptions of content and appropriate correlated patterns (user models/profiles, action plans and treatments, etc.). The overall system will enable the remote healthcare professional to continuously monitor the patient on a context aware multi-parametric basis. The output of the sensors will produce an effective picture of the patient's overall physiological status and lifestyle. The clinical modelling and prediction functionalities that are executed in the Application Layer allows the definition of a parametric computational asthma model of airway and lung dynamics that will be subsequently customized for each individual patient. Then, based on the personalized patient computational model, the health records, the available environmental and clinical measurements, prediction of the clinical state of the individual will be performed. Finally, patient models developed in the Knowledge layers will provide a structured machine readable patient representation format allowing a personalized feedback to the patient (behavior/habits change, reminders, etc.).

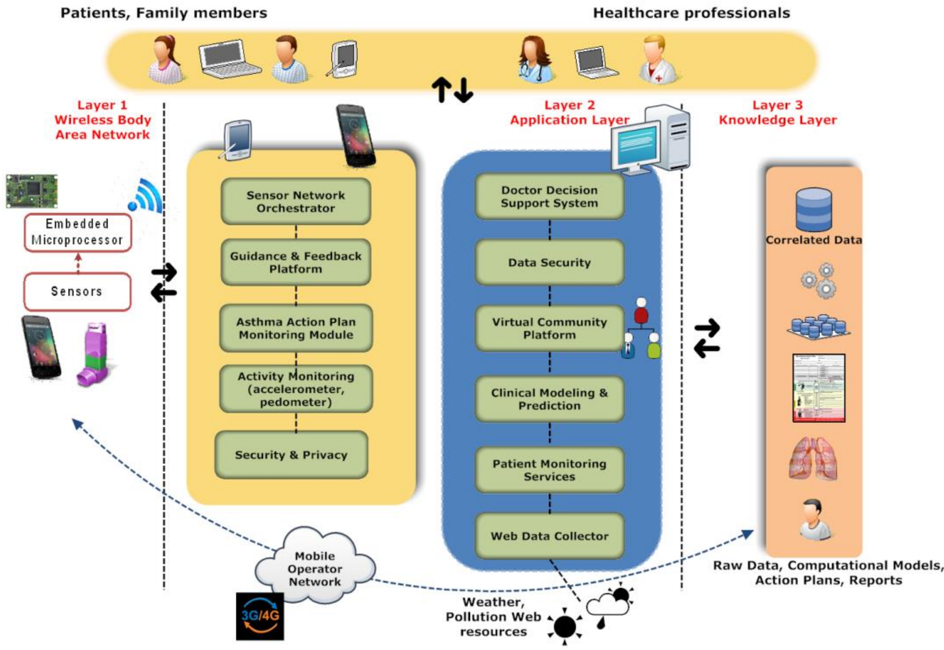

Figure 1: Proposed MyAirCoach Architecture

Evaluation and Quantification Campaigns

The evaluation and quantification of the proposed system will be based on test campaigns with real patients. The aim of the myAirCoach evaluation campaigns will be twofold. In the first half of the project they will be performed so as to i) ground the model with experimental data and ii) quantify and fine-tune the developed patient computational models and clinical state prediction framework. While in the second half of the project, they will involve pilot execution in distributed pilot sites. The outcome will serve both model optimization and validation purposes and help in identifying redundant clinical assessments. Once the myAirCoach prototype has been developed and undergone successful validation testing, it will be utilized in a structured two-stage pilot quantification study with the objectives of testing feasibility of myAirCoach in everyday use, and secondly proof of concept that myAirCoach improves asthma control.

Conclusion

The proposed system will allow asthma patients to manage their disease in their home or at work, eliminating the need to have frequent face-to-face contact with healthcare.

References

[1] European Lung White Book. Available at: http://www.erswhitebook.org/chapters/adult-asthma/ (Assessed 2014)

[2] Holt, Patrick G., and Peter D. Sly. "Viral infections and atopy in asthma pathogenesis: new rationales for asthma prevention and treatment." Nature medicine (2012).

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asthma monitoring, computational modeling, dynamic simulation.