Chapter 10
Decision Support in the Elderly Healthcare: Combing Short- and Long-Term Analysis Aspects

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ABSTRACT
Ambient assisted living environments comprise of “smart” components that play the role of a “guardian angel” for the seniors. Health monitoring algorithms have been widely presented in the literature, however in most of the cases, they examine contextual information and the production of alerts in case of an emergency. This short-term information, needs to be combined also with respective analysis in the long run. Integrating both types of temporal information regarding the health status of seniors, one can safeguard that both emergency detection and early diagnosis of health deterioration would lead to increase feelings of safety and quality of life to baby boomers. This chapter aims at presenting the open questions regarding health monitoring in AAL environments and proposes an approach that combines both contextual and long-term trends to characterize overall health.

INTRODUCTION
Senior citizens suffer nowadays from a wide variety of chronic conditions that reduce their independency level and deteriorate their health status (Lowry, 2013). Recent technological advances resulted in the equipping of home environments with a plethora of sensors that aim to improve the seniors’ quality of life and increase their independency by providing alerts in case of emergencies while increasing their socialization (Lotfi A. et al., 2012). These approaches provided
significant results in cases of fall detection, dangerous use of electricity devices, estimation of participant’s functionality, etc. (Wang F. et al., 2013). However, they have mainly focused on the detection of life-threatening acute events and they neglected the significance of slow-varying trends that may influence the health status of senior citizens (Mihailidis A., 2008).

Several wearable sensor systems have been utilized in literature as health monitoring platforms for the provision of elderly care (for a review see Pantelopoulos & Bourbakis, 2010). Most of these system have proven that their suitable for accurate detection of health problems and pathological patterns, however they involve wearable sensors and mainly focused on specific types of activities and deterioration alerts (e.g. heart problems, falls). Subsequently, there seems to exist a significant trade-off between monitoring accuracy and unobtrusiveness. Unobtrusiveness seems to be a critical factor that leads ultimately to user acceptance and compliance.

Therefore, aiming to fill the above gap, we present a methodology, in the context of the USEFIL project (Artikis A. et al., 2012), that utilizes low-cost, off-the-self, unobtrusive sensors and devices to detect both short-term monitoring - such as the detection of emergency events as well as the detection and assessment of ADLs and other contextual situations (Storf H. et al., 2009)– and, long-term monitoring so as to detect abnormal patterns of health or behavior and continuous health assessment (Chiriac, S., et al., 2012).

The USEFIL project aims to build an innovative data acquisition and processing platform, collecting and fusing data from multiple recording modalities (sensors, exergames, questionnaires, etc.). Therefore, collection of raw data is performed inside the house and is responsible for the data fusion and manipulation towards the production of user reminders and alerts, whereas group-level processing is performed on a central USEFIL database.

The project’s objective is to integrate and extend state-of-the art technologies for:

- Fusing and interpreting the parameters unimodally extracted from raw sensor data into a semantic representation of human behaviour and physiological status.
- Extracting correlations from sets of fused data (cognitive, emotional and physiological measurements). Various soft computing, probabilistic and data mining techniques are considered in order to operate on sensor data to provide least error prone analysis and decision support indicators.

The main DSS objective is the recognition of early deterioration signs for a plethora of generic medical cases and behavioral disturbances in order to alert both formal and informal carers as soon as possible. This is performed by adopting data-mining and pattern recognition techniques operating in three-steps:

1. Acquisition of the essential information previously filtered and processed.
2. Projection of given data segments into a time-series for recognition of patterns
3. Classification of temporal fluctuations to certain diagnosis types

Aiming to accomplish the aforementioned objectives, the USEFIL DSS system is designed to be a spatio–temporal model consisted of artificial intelligence methods manipulating data related with user activity and physiological classification. Various soft computing, probabilistic and data mining techniques are applied on the
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