

# Dem@Care: Ambient Sensing and Intelligent Decision Support for the Care of Dementia

Thanos G. Stavropoulos, Georgios Meditskos, Stelios Andreadis  
and Ioannis Kompatsiaris

Information Technologies Institute, Center for Research and Technologies - Hellas, Greece  
{athstavr, gmeditsk, andreadisst, ikom}@iti.gr

**Abstract.** This paper presents an overview of the Dem@Care framework, for intelligent support of dementia care. Dem@Care integrates a wide variety of ambient and wearable sensor modalities, together with sophisticated, interdisciplinary methods, such as image, audio and semantic analysis. Semantic Web technologies, such as OWL 2, are extensively employed in the framework to represent sensor observations and application domain specifics as well as to implement hybrid activity recognition and problem detection solutions. Complete with tailored user interfaces, Dem@Care supports a variety of clinical scenarios for assessment and long-term monitoring, towards adaptive interventions for the optimal care of dementia.

**Keywords:** ambient assisted living, sensors, semantic web, ontologies, reasoning, context-awareness

## 1 Introduction

The increase of the average lifespan across the world has been accompanied by an unprecedented upsurge in the occurrence of dementia with high socio-economic costs. The development of personal health systems provides the necessary medium to deal with such problems in a meaningful and sustainable manner, enabling individuals with dementia to maintain independence and societal inclusion, while improving their quality of life and the effectiveness of their caregivers.

Dem@Care provides an integrated solution for personal health services to individuals with dementia, as well as medical professionals and caregivers, by using a multitude of sensors, context-aware, multi-parametric monitoring of lifestyle, ambient environment, and health parameters. Multi-sensor data analysis combined with intelligent decision making mechanisms facilitates an accurate representation of the individual's current status and provides the appropriate feedback so as to enhance the standard clinical workflow. The aggregation of information from complementary sources, which is a critical aspect in multi-sensor processing, is addressed by Dem@Care with advanced knowledge representation and ontology-based semantic interpretation methodologies. The system has already been deployed in home and nursing home settings in Ireland, France, Sweden and Greece, providing clinicians

with a comprehensive tool for the remote monitoring of the individuals' condition and its progression.

## 2 Multi-Sensor Interoperability and Semantic Interpretation

Dem@Care proposes a multidisciplinary approach that brings into effect the synergy of the latest advances in sensor technologies addressing a multitude of complementary modalities, large-scale fusion and mining, knowledge representation and intelligent decision-making support. In detail, the framework integrates several heterogeneous modalities, such as raw sensor input, real-time processing, higher-level audio and image analytics, providing their unanimous semantic representation and interpretation. Dem@Care leverages not only open-source sensor solutions, but also proprietary low-cost health monitoring devices, which are now dominating the market. A unified semantic representation is established to unambiguously store information from all sensors in the form of measurements together with state-of-the-art activity detection from image and audio analysis.

Semantic interpretation allows the intelligent temporal fusion and aggregation of such events, and the identification of problematic situations, which are both crucial to clinical monitoring and interventions. Through a hybrid combination of SPARQL queries and OWL 2 reasoning, as well as the incorporation of context-aware semantic similarity measures, Dem@Care provides a multi-parametric monitoring of daily activities, lifestyle and behavior, supporting clinicians to obtain a comprehensive image of the person's condition and its progression, without being physically present.

The framework is complemented by applications oriented to especially aid such clinical scenarios for monitoring and interacting with patients in the context of dementia care. Evaluation in such pilot scenarios has revealed high accuracy for both image and semantic analysis algorithms for activity detection. In turn, the methods have been used for assessment support and long-term, residential dementia care through tailored interventions.

