Chapter 15
Situation-Aware Ambient Assisted Living and Ambient Intelligence Data Integration for Efficient Eldercare

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ABSTRACT

Pervasive healthcare systems are designed to support elderly and care-dependent people to live an independent life. Recent developments are driven by technological advances of wireless sensor networks and mobile devices, which ease their application in the health- and homecare domain. The integration into pervasive healthcare systems helps to improve the impact and the efficiency of eldercare, while keeping financial efforts at a moderate level. The importance of these issues leads to the development of systems covering situation-aware, ambient assisted living and health data exchange between care institutions and ambient assistant solutions. Various projects within the Ambient Assisted Living (AAL) domain have proven that remarkable results can be achieved by using wireless sensor technology and mobile devices for data collection, but there are still several problems concerning the exchange and integration of healthcare data. This chapter gives an overview about AAL, healthcare related standards, and state of the art approaches for data integration. In addition, best practice projects, which deal with patient-oriented care information, ambient assisted living, as well as ambient intelligence, are covered.

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INTRODUCTION

Due to population aging and longer life expectancy our society faces serious challenges. This concerns especially the growing group of elderly people (Madsen, Serup-Hansen, & Kristiansen, 2002). One important challenge for elderly people is to extend the time they can remain (independently) in their familiar environment (Rennemark & al., 2009). Pervasive home healthcare services and systems help to maintain the health and functional capabilities of individuals, support people with chronic illnesses or disabilities and are one prerequisite for an independent ageing at home.

Nowadays, pervasive home healthcare systems are often composed of numerous independent *living assistants* with the purpose to support elderly persons and persons with special needs in their activities of daily living. Proposed living assistants often include features, like item tracking and searching, warning of household dangers (slippery floor, unattended stove, running water taps), recognition of critical situations (collapse, fall), as well as remote health monitoring and data exchange with nursing facilities and care institutions. The coherent information gained from various living assistants increases the scope of detectable situations, improves the fault tolerance of the systems, and leads to a richer user experience.

Various projects within the *Ambient Assisted Living* (AAL) domain have achieved remarkable results by using wireless sensor technology for data collection, but still face problems concerning the exchange and integration of healthcare data (Wozak, Ammenwerth, Hörbst, Sögner, Mair, & Schabetsberger, 2008), (Burgsteiner & al., 2009). Thus, feasible healthcare systems have to cope with several problems: *(i)* patient data exchange across institutional borders, such as nursing homes, hospitals or AAL equipped retirement homes, *(ii)* data integration from various sources, and *(iii)* automated processing of unstructured or semi structured data.

The integration of data from various sources is a typical *data fusion* problem. One possible solution is to apply the *JDL Data Fusion Model* (Llinas, Bowman, Rogova, & Steinberg, 2004). The process described by this model covers the perception of sensor data, the detection of specific situations and the evaluation of a possible situation evolution. Besides, the JDL Data Fusion Model there are other models and/or processes that cope with the problem of multi sensor data fusion, like Luo and Kay's architecture for information systems (Paradis & Treurniet, 1998), Pau's Sensor Data Fusion Process (Esteban, Starr, Willetts, Hannah, & Bryanston-Cross, 2005), the Omnibus Data Fusion Model (Bedworth & O'Brien, 2000) or the Waterfall Data Fusion Model (Bailey, Dodd, & Harris, 1998). Most are based on the findings of Endsley, who developed a model of situation awareness in dynamic decision making based on human beings (Endsley M. R., 2000), (Endsley M., 1998).

A situation aware system, based on data fusion, can support eldercare in the field of homecare, but lacks the ability to integrate data from different external data providers (hospitals, care institutions) in a standardized way. To solve such integration issues researchers, like (Kokar, Matheus, & Baclawski, 2009) and (Baumgartner & Retschitzegger, 2006) propose models for data fusion and situation awareness based on ontologies to support knowledge sharing among different domains. Transforming theses concepts into the AAL domain enables electronic exchange of patient data and establishes compliance with international standard recommendations, like *Integrating the Healthcare Enterprise* (IHE).

Efficient exchange of electronic patient record data between different health service environments is a challenge, since: *(i)* semantically correct exchange of patient data requires appropriate care data models and *(ii)* incomplete or contradictory care information must be identified and completed or corrected (intelligent mapping process). Stan-