Chapter 31
DeepKøver: An Adaptive Intelligent Assistance System for Monitoring Impaired People in Smart Homes

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ABSTRACT

The chapter presents a novel modular adaptive artful intelligent assistance system for cognitively and/or memory impaired people engaged in the realisation of their activities of daily living (ADLs). The goal of this assistance system is to help disabled persons moving/evolving within a controlled environment in order to provide logistic support in achieving their ADLs. Empirical results of practical tests are presented and interpreted. Some deductions about the key features that represent originalities of the assistance system are drawn and future works are announced.

INTRODUCTION

Improvement of life quality in the developed societies has systematically generated an increase in the life expectancy. Nevertheless, the increasing number of elderly person requires more resources for aftercare, paramedical care and natural assistance in their habitats. The situation is further complicated if elders suffer from memory and/or cognitive disorders (Pigot et al., 2008). In this case a permanent assistance is necessary wherever they are. In recent years, some researches (Boger et al., 2006; Mihailidis et al., 2004; Snoek et al, 2008; Tam et al., 2006) proposed intelligent systems to assist elders with cognitive and/or memory troubles to carry out complex daily activities. To maximize their efficiency, such systems require

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continuous identification of what the impaired person is doing, recognizing its intentions and analyzing the tasks partially carried out; in order to help him/her (if need arise) to achieve and finalize what is already undertaken. However, several specialized works and thematic books (see for example Solie (2004), Beerman & Rappaport-Musson (2008) and Loverde (2009)) underline the difficulties encountered on the human, relational and social planes; also on the communication level between elders receiving aid and those who lend them assistance. A frequently raised key question which always returns is how convincing an elder to comply when s/he flatly refuses? Moreover, things are harder when dealing with stubborn aggressive seniors (Marcell & Shankle, 2001). In other words, how getting an elderly person to listen and make him/her apply optimal sequence of instructions for a safe realisation of activities of daily living (ADLs) without given him/her the impression to command him/her?

This chapter presents *DeepKϕver,* a novel modular adaptive a*rtful* intelligent assistance system for cognitively and/or memory impaired people engaged in the realisation of their ADLs. The goal of this assistance system is to help disabled persons moving/evolving within a controlled environment in order to provide logistic support in achieving their ADLs. The D*eepKϕver p*hilosophy is to make the occupier of an intelligent habitat, which is an elderly person (and possibly stubborn and obstinate) feel in a position of leader; i.e., giving him/her the illusion of "ca*lling the tune"*. Thus, the system becomes user-friendly without showing any dominating or directive behaviour. But this is only an illusion; because for cases considered to be critical where the situation is likely to become alarming, and even dangerous, the system imposes its total control and acts in an authoritative way by refusing to the occupier the achievement of certain tasks and dictating its course of actions. Therefore, De*epKϕver pl*ays a double game: an accompanying adviser for the elder on one hand and a "par*tially high-handed" r*egulator on another hand. In this sense, the assistance system reveals "dee*p cover" i*ntrigues.

The detection of the undertaken activities (for example, preparing pasta in the kitchen, watching movie in the living room or taking a shower) is based on data that simulate information transmitted by sensors in an intelligent apartment. De*epKϕver ca*lls a Hidden Markov Model (Rabiner, 1989) for the recognition of the activities in progress. A planning module uses Markov Decision Processes (Dietterich, 1998) in dynamic multi-tasks planning to help the elder achieve and finalize ADLs. The remainder of the article is organized as follow. Section 1 presents the modular architecture of Dee*pKϕver and* describes its components. Section 2 is dedicated to the experimental validation where empirical results of practical tests are presented and interpreted. In section 3, we discuss the obtained results and draw some deductions about the key features that represent the originalities of Deep*Kϕver. We* announce our future work in section 4 and in the last section – by way of conclusion – we sum up this research work.

THE MODULAR ARCHITECTURE

The modular architecture is composed of five (5) modules: the scenarios generation module (SGM), the recognition module (RM), the analysis module (AM), the diagnosis module (DM) and the planning module (PM). These modules operate and handle shared data represented in XML structures. The modules communicate by messages. A database gathers randomly generated scenarios (via the SGM) which are used during simulations for the reconstitution of real events. Figure 1 illustrates the general view of the architecture.

The overall environment is an accessible structure. Data in the environment allow the modules to reason in order to properly achieve their functionalities. Modifying the environment is performed via an exclusive write access grant-

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