

Intelligent Recognition of Activities of Daily Living for Assisting Memory and/or Cognitively Impaired Elders in Smart Homes

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ABSTRACT

The article describes a recognition approach of undertaken activities of daily living (ADLs) performed by memory and/or cognitively impaired elders in smart homes. The proposed technique is materialised via a recognition module inserted in a modular generic architecture which aims to offer a framework to conceive intelligent ADLs assistance systems.

Keywords: Activities of Daily Living, Ambient Intelligence, Assisted Living, Smart Homes,

INTRODUCTION

Improvement of life quality in the developed nations has systematically generated an increase in the life expectancy. Nevertheless, the increasing number of elderly person implies more resources for aftercare, paramedical

care and natural assistance in their habitats. The situation is further complicated if elders suffer from memory disorders (Pigot et al., 2006). In this case a permanent assistance is necessary wherever they are. During the last decade, some researches (Boger et al., 2006; Mihailidis et al., 2004; Snoek et al, 2008; Tam et al., 2006) have proposed intelligent systems to assist elders with memory troubles to carry

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out complex daily activities. To maximise their efficiency, such systems require continuous identification of what the memory impaired person makes, recognising its intentions and analysing the tasks partially carried out; in order to help him/her (if need arise) to achieve and finalise what is already undertaken. However, the major phase of this assistance process is the recognition of what really occurs within the habitat; since the intelligent system reaction – in term of optimal planning of tasks to be made or terminated—for better assisting the occupant is based primarily on what does this system “*think*” that is happening.

This article describes a recognition approach of undertaken activities of daily living (ADLs) performed by memory and/or cognitively impaired elders in smart homes. The proposed technique is materialised via a recognition module inserted in a modular generic architecture which aims to offer a framework to conceive intelligent ADLs assistance systems. The remainder of the article is organised as follows. Section 1 presents the modular architecture and its components. Although the main subject of the article is the recognition module (RM), the goal of this section is to enlighten the reader about the context in which the RM is used, the stochastic model of the recognition in the RM, as well as the interaction between the various modules of the modular architecture. 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 act upon the efficiency of the ADLs recognition. 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 done via an exclusive write access granted to only one component of the architecture (this detail will be clarified below). To make the environment easier to consult, reading (R) is managed by a circular order. This can change if a module notifies another and requests its intervention when detecting anomalies or critical situations. The various modules of the architecture reason on data that are collected by parsing an XML file which contains the scenario. As mentioned above, the latter represents a set of events reconstructing simultaneous achievements of several daily activities. Although they are generated randomly, these events are selected according to logical constraints. For example, for the scenario of the realisation of the “coffee preparation” activity, if the events “coffee-maker alarm is ringing”, “coffee cup is full” and “sugar bowl is open” were chronologically generated, then when the event “coffee cup is clean” is generated, it will not be accepted in the scenario. On the other hand, the event “holding the coffee spoon” will be added to the scenario.

An interpreter of scenarios (INT) scans the XML file and—at each temporal unit—sends information relating to one event to the recognition module (RM). Having the exclusive write access (W) on the environment, the interpreter updates it. The environment is a structure that recreates what really occurs in the intelligent apartment thanks to variables which represent all the detectable housing elements (e.g., furniture, kitchen utensils, taps, household electric appliances, etc). In a real context, the state of each detectable element is determined by a set of sensors. Our intelligent assistance system uses an ambient simulator. We have been in-

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