

Chapter 2

Improving an Ambient Intelligence Based Multi-Agent System for Alzheimer Health Care using Wireless Sensor Networks

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ABSTRACT

This paper describes last improvements made on ALZ-MAS; an Ambient Intelligence based multi-agent system aimed at enhancing the assistance and health care for Alzheimer patients. The system makes use of several context-aware technologies that allow it to automatically obtain information from users and the environment in an evenly distributed way, focusing on the characteristics of ubiquity, awareness, intelligence, mobility, etc., all of which are concepts defined by Ambient Intelligence. Among these context-aware technologies we have Wireless Sensor Networks. In this sense, ALZ-MAS is currently being improved by the use of a new platform of ZigBee devices that provides the system with new tele-monitoring and locating engines.

INTRODUCTION

The continuous technological advances have gradually surrounded people with a wide range

of electronic devices and information technology. In this regard, it is necessary to develop intuitive interfaces and systems with some degree of intelligence, with the ability to recognize and respond to the needs of individuals in a discrete and often

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invisible way, considering people in the center of the development to create technologically complex and intelligent environments. This paper describes ALZ-MAS; an Ambient Intelligence based multi-agent system aimed at enhancing the assistance and health care for Alzheimer patients in geriatric residences. Furthermore, this paper includes new changes made to this system regarding previous publications (Tapia & Corchado, 2007), including the integration of new wireless sensor devices to improve the system with new and better locating techniques.

Ambient Intelligence (AmI) is an emerging multidisciplinary area based on ubiquitous computing, which influences the design of protocols, communications, systems, devices, etc., proposing new ways of interaction between people and technology, adapting them to the needs of individuals and their environment (Weber, *et al.* 2005). AmI offers a great potential to improve quality of life and simplify the use of technology by offering a wider range of personalized services and providing users with easier and more efficient ways to communicate and interact with other people and systems (Weber, *et al.*, 2005; Corchado, *et al.*, 2008b). However, the development of systems that clearly fulfill the needs of AmI is difficult and not always satisfactory. It requires a joint development of models, techniques and technologies based on services. An AmI-based system consists of a set of human actors and adaptive mechanisms which work together in a distributed way. Those mechanisms provide on demand personalized services and stimulate users through their environment according to specific situation characteristics (Weber, *et al.*, 2005).

One of the most important characteristics of ALZ-MAS is the use of intelligent agents. Agents have a set of characteristics, such as autonomy, reasoning, reactivity, social abilities, pro-activity, mobility, organization, etc. which allow them to cover several needs for Ambient Intelligence environments, especially ubiquitous communication and computing and adaptable

interfaces. Agent and multi-agent systems have been successfully applied to several Ambient Intelligence scenarios, such as education, culture, entertainment, medicine, robotics, etc. (Corchado, *et al.*, 2008b; Sancho, *et al.*, 2002; Schön, *et al.* 2005; Weber, *et al.* 2005). The characteristics of the agents make them appropriate for developing dynamic and distributed systems based on Ambient Intelligence, as they possess the capability to adapt themselves to the users and environmental characteristics (Jayaputera, *et al.*, 2007). The continuous advancement in mobile computing makes it possible to obtain information about the context and also to react physically to it in more innovative ways (Jayaputera, *et al.*, 2007). The agents in ALZ-MAS are based on the deliberative Belief, Desire, Intention (BDI) model (Jennings & Wooldridge, 1995) (Bratman, *et al.*, 1988; Pokahr, *et al.*, 2003), where the agents' internal structure and capabilities are based on mental aptitudes, using beliefs, desires and intentions (Bratman, 1987; Erickson, *et al.*, 1995; Geogeff & Rao, 1998). Nevertheless, Ambient Intelligence developments need higher adaptation, learning and autonomy levels than pure BDI model (Bratman, *et al.*, 1988). This is achieved by modeling the agents' characteristics (Wooldridge & Jennings, 1995) to provide them with mechanisms that allow solving complex problems and autonomous learning. An essential aspect in this work is the use of a set of technologies which provide the agents with automatic and real-time information about the environment, and allow them to react upon it. In this sense, most of the context information can be collected by distributed sensors throughout the environment and even over the users themselves. It is possible to distinguish between two types of sensor networks: wired and wireless. Wireless Sensor Networks (WSNs) are more flexible and require less infrastructural support than wired sensor networks (Sarangapani, 2007). Although there are plenty of technologies for implementing WSNs (*e.g.*, ZigBee, Wi-Fi or Bluetooth), it is not easy to

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