



# An Ambient Intelligence Based Multi-Agent System for Alzheimer Health Care

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## ABSTRACT

*This article describes 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.*

*Keywords: ambient intelligence; health care; multi-agent systems; wireless technologies*

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## INTRODUCTION

The continuous technological advances have gradually surrounded people with devices and technology. 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 invisible way, considering people in the centre of the development to create technologically complex and intelligent environments. This article describes ALZ-MAS; an Ambient Intelligence based multi-agent system aimed at enhancing the assistance and health care for Alzheimer patients in geriatric residences.

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). It 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 fulfil 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 on 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 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 of adapting 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 modelling 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 automatic and real time information of the environment, and allow them to react upon it.

In the next section, the problem description that motivated the development of ALZ-MAS is presented. Section 3 describes the basic components of ALZ-MAS and the most important technologies used to provide the agents in ALZ-MAS with context-aware capabilities. Finally section 4 presents the results and conclusions obtained.

## PROBLEM DESCRIPTION

Dependence is a permanent situation in which a person needs important assistance from others in order to perform basic daily life activities such as essential mobility, object and people recognition, and domestic tasks (Costa-Font & Patox, 2005). There is an ever growing need to supply constant care and support to the disabled and elderly, and the drive to find more effective ways of providing such care has become a major challenge for the scientific community (Nealon & Moreno, 2003). The World Health Organization has determined that in the year 2025 there will be 1 billion people in the world over the age of 60 and twice as many by 2050, with nearly 80% concentrated in developed countries (WHO, 2007). Spain will be the third "oldest country" in the world, just behind Japan and Korea, with 35% of its citizens over 65 years of age (Sancho, *et al.*, 2002). In fact, people over 60 years old represent more than 21% of the European population (WHO, 2007), and people over 65 are the fastest growing segment of the population in the United States of America (Anderson, 1999). Furthermore, over 20% of those people over 85 have a limited capacity for independent living, requiring continuous monitoring and daily assistance (Erickson, *et al.*, 1995). The importance of developing new and more reliable ways of providing care and support for the elderly is underscored by this trend, and the creation of secure, unobtrusive

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