

# Chapter 39

## MIMO: Multi-Agent System for Personal Health Monitoring

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### ABSTRACT

*According to previsions, Spanish population over 65 years old will soon be an important fraction. For the EU region, old-age dependency ratios will more than double in 2000 to 2050, decreasing, at the same time, the ratio of persons of working age to every elderly people. These data show the need for some helping technologies that make possible to deal with this scenario. One of the possibilities explored is the use of some kind of intelligence at home. This chapter describes the current status of the ambient intelligence (Aarts, Rabaey, & Weber, 2005) initiatives that link multi-agent technologies with personal monitoring for health and wellbeing. The aim is to explore various enabling technologies based on environmental intelligence, by means of which the user interacts with his or her home in various scenarios: home assistance and wellbeing, entertainment, identity management in a home environment, and location*

DOI: 10.4018/978-1-61520-670-4.ch039

*management in a home. All these possibilities are intended to satisfy the objective of home assistance and wellbeing, and it fits well within Ambient Assisted Living Joint Programme (AAL) ("Ambient Assisted Living," 2008) partly funded by the European Commission. The authors will focus this technology on a personal health monitor integrated with the multi-agent system for home environments created by Telefónica R+D in cooperation with the Departamento de Informática y Automática of the University of Salamanca and the Computer Science Department of the University of Valladolid, Spain. This research aims to explore the use of several device discovery technologies and ambient intelligence techniques in order to allow the user interaction at home as transparent as possible. To achieve this goal a multi-agent system is proposed, focussing on knowledge representation for multi-agent system communication and personal health monitoring.*

## INTRODUCTION

The main objective of this project is to provide a user-friendly system that can be easily used by people of any age and with or without technological knowledge to interact with a technological environment. One must point out two important issues: the interaction between the system and the home around it, and the application of technologies that allow automatic discovery and integration of various devices.

Clearly, the number of wearable devices available in the market is growing, but they lack real time connectivity. This connectivity must be provided by a personal gateway that acts as a central entity for the reception and delivery of information between wearable devices and the home area network. This personal gateway could be a mobile phone or a PDA, and it will provide autonomous services. Moreover, it must be integrated with the residential gateway and any other devices inside the home network.

We propose a scenario in which a Bluetooth pulsioxymeter measures the heart rate, oxygen saturation and pletismographic wave of the patient. When the user gets home with his new vital signs monitor, it is to be desired that the device will integrate transparently with the intelligent environment. Hence, one can anticipate the following challenges in a home environment: (1)

standardizing device access and (2) facilitating the introduction of new devices with a minimum of user interaction.

As an example of the services that can be provided, the personal health monitor can control the SpO<sub>2</sub> level. But the monitoring device does not make decisions about these levels by itself. Instead of that, an intelligent agent is in charge of discovering that an ill condition could happen because the oxygen level is getting down. The agent asks the knowledge system what to do regarding this the sudden fall, taking into account the user's history. The patient will be informed of a potentially dangerous situation for which action should be taken. Additionally, the user could be informed by means of a voice alarm in his PDA that his heart rate is increasing, and he should stop and get some rest. If necessary a physician will be notified by means of an MMS with the pulsioxymeter graphic.

It is necessary for all these devices to put their services at the disposal of the home in a standard way. In order to achieve this, an overlay is needed that allows the vital signs and other sensors or actuators to announce their services to the home network. This is done by means of a PDA or a *Home Gateway*, which exports device services. Thus, when the user acquires a new device and takes it home, the home platform will discover it automatically, with no intervention on the user's

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