Chapter 3
An Ambient Multi-Agent System for Healthcare Monitoring of Patients With Chronic Diseases

Imane Boussebough
Constantine 2 University, Algeria

Issam Eddine Chaib
Constantine 2 University, Algeria

Billel Boudjit
Paris 13 University, France

ABSTRACT

Chronic diseases are a major cause of death in the world. Thus, many guidelines have been proposed to prevent these diseases. In addition, various systems have been developed to ease health monitoring. However, they are generally behaving as reminders or as anomaly detection systems. After giving an overview of the existed solutions and discussing their drawbacks, the authors present their system which is called ambient healthcare monitoring system (AHMS). It provides a continuous, unobtrusive, and mobile health monitoring of patients with chronic diseases. It is based on the multi-agent paradigm that allows devices to be distributed and autonomous. In addition, it benefits from the characteristics of ambient intelligence (AmI) such as ubiquity and context-awareness. So, AHMS is a promising solution for unobtrusive healthcare monitoring, in which it offers efficient medical services, with less energy consumption, that can significantly reduce the healthcare cost by automating some routine tasks. Consequently, it reduces the latency as well it minimizes the overload on the caregiver.

DOI: 10.4018/978-1-5225-7071-4.ch003

INTRODUCTION

Chronic diseases are among the most widespread diseases in the world. According to the World Health Organization (WHO) (World Health Organization, 2017), in 2015 an estimated 1.6 million deaths were directly caused by diabetes and 17.7 million people died from cardiovascular diseases (CVDs). Thus, healthcare organisations provide various guidelines and recommendations to help patients to deal with these chronic diseases. They recommend respecting diet, controlling vital signs, taking medications and doing physical activities to treat chronic diseases. But, these guidelines limit the patients' lifestyle where a patient should frequently measure his/her physiological parameters and he/she should often visit his/her doctor.

During the past decade, technology had been moving gradually towards Ambient Intelligence (AmI) environments aiming to help inhabitants in everyday life (Hristoskova, Sakkalis, & Zacharioudakis, 2014). AmI tries to adapt the technology to the peoples' needs using omnipresent computing elements, which communicate amongst them in a ubiquitous way (Tapia, Abraham, Corchado, & S.Alonso, 2009). In particular, AmI systems can considerably enhance the healthcare domain (Acampora, Cook, Rashidi, & V.Vasilakos, 2013). Due to the fact that health monitoring of patients within a controlled environment (e.g. hospitals) will disturb them, researchers have proposed to monitor the patients within smart environments, which use AmI technologies. However, previous work has only focused on facilitating the vital sign measuring task, detecting any occurred abnormal situation, and helping caregivers to make suitable decisions. So, these systems can be viewed as reminders (e.g. they remind the patient when the time of taking a drug has arrived) or as anomaly detection systems (e.g. they alert caregivers when a patient is on a critical health situation) or as decision support systems (e.g. they provide to doctors clinical analyses and documentation that assist them to make decisions).

Although the previous solutions are interesting, they don't have mechanisms to apply treatments, in which these systems need for a direct intervention of caregivers. Moreover, patients in critical health situation need for an immediate intervention, where any unnecessary delay can cause the death of the patient. In this purpose, the authors present a multi-agent system named *Ambient Healthcare Monitoring System (AHMS)*, which allows patients to control their health everywhere, at any time, and in an unobtrusive manner without limiting their lifestyle. So, the patient doesn't need to measure his/her vital sign regularly. Instead, the system measures them in a transparent manner using wearable sensors. Also, AHMS helps doctors to remotely monitor the patients' health in real-time by providing a detailed medical information about them. Besides, it uses the guidelines of caregivers (which are saved on the knowledge base) to make instantaneous decisions. These decisions will be directly applied by actuator devices (i.e. it don't need a physical intervention of caregivers). Especially in emergency situations where a delay is not accepted.

The remainder of this chapter is organised as follows: Section 2 presents an overview of the existing systems for health monitoring. Section 3 describes the proposed system, by presenting its objectives, its general architecture, and describes its various agents. An experimental scenario is presented in Section 4, to deepen the understanding of the AHMS operation. Finally, a conclusion and some future works are mentioned in Section 5.