

## Chapter 2

# Internet of Things in Pervasive Healthcare Systems

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### ABSTRACT

*Throughout the stunning development of wireless communication technologies, sensors and wireless sensor networks (WSN) are being used in almost every area, such as in healthcare field. The ubiquitous sensing enabled by WSN technologies, in particularly the wireless medical sensor network (WMSN), might be one important key success factor in the modern medical system. The recent advances, and wireless devices proliferation, had proved the technical feasibility of the pervasive health care systems. The data collected by sensors are very sensitive and important, and the leakage of them could compromise security and privacy. This work presents the pervasive health care systems (PHCS) focusing on security and privacy of pervasive environments.*

### INTRODUCTION

Nowadays, Internet of things and the ageing of world population are reshaping the world. It's expected that world population with 60 years or more reach 22% in 2050 (11% in 2009) (Department of Economic and Social Affairs of the United Nations, 2009). In the case of European Union (EU) it's projected to increase 30% in 2050 (22.5% in 2005) (Eurostat, 2008), and in United States 20.2% (13% in 2010) (Vincent & Velkof, 2010). In this context, resources and efficiency of health care services must to be improved to fulfill such group of people.

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In 1990, the 27 EU Member States public health expenditure averaged 5.9% of GDP, increased to 7.2% in 2010 and being expected to reach 8.5% in 2060, as result of population aging and others factors (cultural and socio-economics). This trend will be accompanied by an expected decline of working-age population from 61% to 51% of the total population. Deep structural reforms are needed to ensure the sustainability of health systems, while ensuring that all citizens have access to services (UE, 2012). The impact of these changes is visible, being conditioned by the decrease in the number of health professionals, by the increasing increase in the incidence of chronic diseases, by the requirement of the citizens of a better quality in the services and the assistance.

On the other hand, the dissemination of wireless characteristic on almost fields of technology is promising new approaches to address challenges faced by the health care sector.

Healthcare technologies had provided suitable solutions powered by the ubiquitous identification, sensing and communication capacities, whereas all system's objects may be continuously tracked and monitored (Alemdar, 2010; Portela, Santos, Silva, Machado, Abelha, & Rua, 2014).

Nowadays' scenario delivered by global connectivity of the Internet of Things (IoT), enable efficiency on collecting, management and use of all healthcare devices' information (Domingo, 2012), leveraged through intelligent and ubiquitous systems (Portela, Santos, Silva, Machado, Abelha, & Rua, 2014).

The IoT systems integrates many different types of devices, like sensing, communication, identification, networking, information management, and systems that links people and things at anytime and anywhere, through any device and media, accessing any information from any object to obtain any service in a more efficiently mode (European Commission Information Society, 2009).

The healthcare delivery model has been evolved from different perspectives from the hospital centric view, passing to hospital home balanced projected by 2020, until the home centric view to 2030 (Koop et al., 2008).

IoT is presented as a new paradigm of information and communication technology being exploited by industry, offering a huge potential to every areas (Atzori, Iera, & Morabito, 2010) in particular the healthcare system (Miorandi, Sicari, De Pellegrini, & Chlamtac, 2012). Such advances had enabled the transformation of the healthcare system view, from a career-centric view to patient-centric view (Pang, Zheng, Tian, Kao-Walter, Dubrova, & Chen, 2015).

This work, following the introduction, goes by the background concepts exposition through Internet of Things, Wireless Sensor Network, Pervasive Health Care Systems and contextualizing of the work. The focus of section three is the security and privacy in pervasive health care systems (PHCS) in of pervasive environments. The article ends by the conclusions section whereas final remarks and future work is addressed.

## **BACKGROUND**

### **Internet of Things**

The IoT (Guillemin & Friess, 2009) paradigm relates a world set of physical objects provided with sensors and actuator triggers connected through wireless networks over internet, setting and enabling an intelligent objects network capable to collect data, processing information and execute actions accordingly. Those objects communicate each other and with others resources (physical or virtual) expanding initial system throughout its boundaries. IoT will allow people and things to be connected Anytime, Anyplace,

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