Chapter 1
Background on Context–Aware Computing Systems

Amina Hameurlaine
University of Constantine 2, Algeria

Samiha Brahimi
University of Constantine 2, Algeria

ABSTRACT

This chapter is consecrated to provide background information that encompass the basic concepts of context-aware pervasive computing systems. The major challenges that researchers need to consider when conducting research in context-aware pervasive computing systems and the most interesting approaches that can be used in order to deal with these challenges are reviewed. This chapter describes also the basic design principles of context-aware pervasive systems and depicts different models for representing and reasoning upon contextual information and an overview of the most known development frameworks of context-aware systems and application adaptation is presented too. Moreover, this chapter describes the usefulness of using context-awareness in ubiquitous healthcare domain and the major challenges in using context-awareness in this domain. The well-known works that have been proposed in the field of Ubiquitous healthcare are discussed too.

INTRODUCTION

Nowadays, with Ambient Intelligence paradigm (AmI)(Marzano, 2003) we are surrounded by a multitude of embedded and smart devices, including sensors, actuators, smart phones, tablets, cameras, etc. which interact and exchange information using wireless communication technology. This paradigm involves the fields of ubiquitous/pervasive computing (Weiser, 1991) and context awareness (B. N. Schilit & Theimer, 1994). The later has been recognized as an important characteristic of pervasive systems where a multitude of smart devices and sensors collects data, interact, exchange information and provide various significant services in our life (Agoston, Ueda, & Nishimura, 2000): controlling our home, monitoring our health, alerting in case of dangerous conditions, assisting us in driving, supervising our children on their way to school, organizing our shopping lists and taking care of time-tabling. Context-aware applications are becoming increasingly more prevalent and can be found in the areas of wearable computing, mobile computing, robotics, adaptive, intelligent user interfaces, augmented reality, adaptive computing and intelligent environments. Implementing a context-aware system requires addressing many issues still faced with enormous challenges in both research and practice. The most interesting challenges are: How to acquire context, how to represent context, and how to reason upon context. Also, the adaptation to the changing computing and networking environment is a major challenge. Besides, the complexity of this kind of systems is steadily increasing.

Ubiquitous or pervasive healthcare (U-Healthcare) (J.-H. Kim et al., 2009) represents one of the main application areas of pervasive computing that provides several services; such as monitoring health and wellbeing of patients anytime and anywhere by using intelligent environment technologies. With the progress of ubiquitous technologies, it is becoming possible to provide more smart and pervasive healthcare services in a smart home environment. These services allow patients to live safely and independently in their own homes. In order to provide such services, those systems must be able to learn about their environment over time, and react rapidly even if they encounter a new situation in which behavioural adaptation is required. This means that they have to adapt their behaviour to the dynamic change of context. In computer science, this kind of concern is known as "context-awareness".

This chapter provides background information regarding the most important aspects related to the context-aware pervasive computing and ubiquitous healthcare systems. Several definitions existing in literature for both pervasive computing systems and context-aware computing systems are given in the second section. The third section presents an overview of the most important challenges facing the design and the development of this kind of systems. In the same section, well-known works related to this field are discussed. Finally the last section concludes the chapter.

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