

## Chapter 6

# Design Aspects and Context Awareness in Pervasive Games

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### ABSTRACT

*Pervasive games are a new type of digital games that combines game and physical reality within the gameplay. This novel game type raises unprecedented research and design challenges for developers and urges the exploration of new technologies and methods to create high quality game experiences and design novel and compelling forms of content for the players. This chapter follows a systematic approach to explore the landscape of pervasive gaming. First, the authors approach pervasive games from a theoretical point of view, defining the four axes of pervasive games design, introducing the concept of game world persistency, and describing aspects of spatially/temporally/socially expanded games. Then, they present ten pervasive game projects, classified in five genres based on their playing environment and features. Following that, the authors present a comparative view of those projects with respect to several design aspects: communication and localization, context and personal awareness aspects, information model, player equipment, and game space visualization. Last, the authors highlight current trends, design principles, and future directions for pervasive games development.*

### INTRODUCTION

Games have been a key motivator in the development of many new technologies and techniques, particularly in the areas of computer graphics and artificial intelligence. Although computer games have been on the spotlight for quite a while,

new forms of gaming, such as web, mobile and pervasive games have recently emerged and attracted academic attention both from design and technological viewpoints (Chalmers et al., 2005).

The most successful paradigm of web games are the Massively Multiplayer Online Games (MMOGs) which enable thousands of players

DOI: 10.4018/978-1-4666-4695-7.ch006

to simultaneously interact in persistent, online, multiplayer-only worlds (Hsiao & Yuan, 2005). Through incorporating highly customizable/detailed avatars, objects, and actions, some MMOGs evolved into MMORPGs (Massive Multiplayer Online Role Playing Games) (Childress & Braswell, 2006). As for mobile games, those are broadly defined as games played on mobile platforms such as cell phones, PDAs and dedicated gaming devices (Davidsson, 2004).

Pervasive computing environments integrate networked computing devices -spanning from tiny sensors to highly dynamic, powerful devices- with people and their ambient environments (Zhu, Mutka, & Ni, 2005). Computers in pervasive environments shift from being localized/static tools to constant companions, enabling continuous interaction and promoting unstructured activities without clear starting or ending points. Pervasive games implement this new role of computational technology to enhance computer game design and computer-gaming experience. Pervasive technology offers three particularly promising dimensions on computer game play:

- Mobile, place-independent game play.
- Integration between the physical and the virtual worlds.
- Social interaction among players (Jegers & Wiberg, 2006).

Pervasive games represent an exciting and commercially promising new form of computer games that builds upon a combination of hybrid interfaces, wireless networking, and context-sensing technologies (Benford, Magerkurth, & Ljungstrand, 2005). Through a combination of personal devices, positioning technologies and other multimedia sensors, combined with wireless networking, a pervasive game can respond to players' movements and context and enable them to communicate with a game engine and with each other (Capra et al., 2005).

As in classic computer gaming, pervasive games may be classified in sub-genres, mainly based on their playing environment and features. The most known pervasive games sub-genres are the following: pure location-based games (IAD, 2011; Kiefer, Matyas, & Schlieder, 2006), mobile games (Chatzigiannakis et al., 2010; Lavín-Mera, Torrente, Moreno-Ger, & Fernández-Manjón, 2009; Peitz, 2006; PK, 2011; Walther, 2005a), trans-reality games (Benford et al., 2004; Benford et al., 2005; Cheok, Sreekumar, Lei, & Thang, 2006; C. A. Lindley & Eladhari, 2005; C.A. Lindley, 2004), augmented reality games (Fischer, Lindt, & Stenros, 2006; Guo, Fujimura, Zhang, & Imai, 2012; C.A. Lindley, 2004; Wetzel et al., 2009) and mixed-reality games (Cheok & Khoo, 2006; C.A. Lindley, 2004). Their corresponding definitions and representative prototypes are discussed later on in this chapter.

The main objective of this chapter is, firstly, to approach pervasive gaming and its design aspects from a theoretical viewpoint (defining the four axes of pervasive games design, introducing the concept of game world persistency and describing aspects of spatially/temporally/socially expanded games). Then to investigate in detail a representative set of pervasive games from several technical angles, so as to highlight the trends and challenges and extract design principles inherent in pervasive gaming (see Figure 1).

- Communication and localization refer to communication facilities (either among players or between players and some kind of game management engine) and localization techniques, which represent a fundamental requirement for pervasive games (Broll, Ohlenburg, Lindt, Herbst, & Braun, 2006).
- Context and personal-awareness criteria deal with gaming environmental and social aspects captured by the games as a means of linking changes in the environment with

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