

3 Pervasive games

In a nutshell, we understand that pervasive games are games that aim at bringing the game experience out of the game device to the physical world. Yet in practice it is not as simple as it might sound.

According to the Oxford English Dictionary (2011), “pervasive” means: *“having the quality or power of pervading; penetrative; permeative; ubiquitous”*. This could suggest that pervasive games are games pervading something (real-world perhaps) or spread somewhere, but there are various interpretations and scopes for defining what “pervasive games” mean, as discussed in Section 3.2. Several works in the literature (see Section 3.2) present “pervasive games” as a concept encompassing different kinds of games that use mobile devices (*e.g.* phones, tablets, PDAs), custom hardware (*e.g.* sensors, augmented-reality peripherals), and even non-technology³⁷ games.

We remind the reader that we are interested in a subset of those games that are based or realized through mobile phones. We are also interested in the technological aspects of pervasive games and their implications, meaning how technology supports or makes it possible the realization of pervasive games.

In this chapter we present an overview of pervasive games, including their origins (Section 3.1), approaches and definitions (Section 3.2), and genre classifications (Section 3.3). The chapter ends with a discussion on how this research work relates to pervasive games (Section 3.4).

3.1 Origins

The research field on “pervasive games” is young. As far as we are aware, no one knows precisely when and where the term “pervasive games” was coined.

³⁷ By “technology in games”, we are referring to devices or technology that supports computing tasks in games, including input and output.

According to Montola and co-authors (2009), this term was probably coined in the year 2001, when important “alternate reality games” (ARGs) were launched³⁸.

In 2001, the most relevant ARG announcement was *The Beast*³⁹. The first game explicitly labeled as “pervasive game” was *Pervasive Clue* (Schneider and Kortuem 2001), dating back from 2001. Around that time, the *Pirates!* game (Björk *et al.* 2001) had been deployed as an example of “game based on ubiquitous computing”. Shortly after, the company It's Alive! has deployed *Botfighters* (Sotamaa 2002), a commercial location-based mobile phone game that uses the real-world as the game arena.

Since then, several researches have tackled this field, and the current result is that there is a variety of approaches to pervasive gaming, meaning that the conceptualization of “pervasive games” is still open in the literature. In Section 3.2, we explore approaches to define pervasive games.

3.2 Approaches to pervasive gaming

This section discusses the main concerns of common approaches for pervasive games found in the literature, as an attempt to help the reader in grasping the main ideas behind those approaches.

When browsing the literature, the reader might become confused by the mixing of viewpoints, terms, and scope of the discussion regarding pervasive games. There are two main groups of approaches for pervasive games: cultural and technological.

With “cultural approach”, this research work refers to approaches originated in areas such as design, game studies⁴⁰, and social studies. In cultural approaches, authors tend to use the term “pervasive” in its original sense⁴¹ to indicate that some game aspects defy concepts that are considered central in traditional game

38 See Section 3.2.1. We consider ARGs as a genre of pervasive games. Montola and co-authors (2009) consider the *Nokia Game* series (launched in 1999) as the first ARG that can be identified as a pervasive game. However, this is questionable, because earlier ARGs could also be considered pervasive games. An interesting timeline with the history of ARGs can be found in www.argology.org/history-of-args.

39 See Section 3.2.1.

40 Please see Chapter 2 for more information about these approaches.

41 As in “dictionaries”. For example, the Oxford English Dictionary (2011).

definitions. The ideas behind definitions in cultural approaches are more concerned with aspects of gameplay and the game itself, not emphasizing technology, pervasive computing and relating ideas.

In technological approaches, authors often discuss pervasive games as applications of pervasive and ubiquitous computing. Another noticeable aspect is the confusion of using the terms “pervasive” and “ubiquitous” in pervasive game definitions, as Nieuwdorp (2007) pointed out.

Those terms have different historical origins. Ubiquitous computing⁴² was a vision Mark Weiser (1991) proposed, implying a new interaction paradigm where computers would adapt to human activities and environments, with computer devices becoming invisible from the user point of view, meaning that users would not have to “think about computers” when using them. In this regard, computing would be spread throughout every-day life. The devices would be small, inexpensive, networked, and context-aware.

Several years later, IBM came up with the term “pervasive computing”. Their vision was “the possibility to access information and services, anytime, anywhere”, mainly focused on “e-business” (IBM Research 1998).

On her research, Nieuwdorp (2007) has pointed out that those terms appear in the literature with different relationships: as synonyms, co-dependent (one uses the other to exist), and as different things. This research work regards those terms as synonyms. Nieuwdorp (2007) analyzed the discourse on pervasive games available in the literature by using a dichotomy between “culture” and “technology”. We use this division as a starting point (with Sections 3.2.1 and 3.2.2) for analyzing some subtle issues present in pervasive games.

As a first look, we categorize the approaches on pervasive games in Table 3.1, according to the author's viewpoint(s).

42 This should not be mixed up with the concept of computers using the brain and body of humans as their peripherals in a similar way humans use computers as their extensions. This is the concept of *Humanistic Intelligence* proposed by Mann (2001) – something that could also be considered part of pervasiveness, where humans and computers are inextricably intertwined.

Viewpoints	References
cultural and technological dichotomy	(Nieuwdorp 2007)
cultural, theater, technology	(McGonigal 2006)
technology, ubiquitous & pervasive computing, sensors	(Magerkurth <i>et al.</i> 2005; Linner <i>et al.</i> 2005; Capra <i>et al.</i> 2005; Walther 2005; Hinske <i>et al.</i> 2007; Benford <i>et al.</i> 2005)
“computer-augmented” game	(Magerkurth <i>et al.</i> 2005; Schneider and Kortuem 2001; Saarenpää <i>et al.</i> 2009)
cultural or game studies approach	(Montola <i>et al.</i> 2009; Montola <i>et al.</i> 2006; Davies 2007)

Table 3.1: Viewpoints on pervasive games

Section 3.2.1 analyzes cultural approaches, encompassing works listed in rows “cultural or gaming approach” and “cultural, theater, technology” of Table 3.1. Section 3.2.2 analyzes approaches based on technological aspects, encompassing works listed in the last two rows of Table 3.1.

Although authors define “pervasive games” through different viewpoints, it is possible to highlight some common patterns in the definitions, which are:

- Spatial mobility on a physical “open” environment, the “game world boundary” is not “well-defined”, sometimes it can be unconstrained;
- The players use mobile devices (*e.g.* smartphones, tablets, custom hardware);
- Focus on promoting social interaction among the players;
- An emphasis on “mixed-reality”. The physical world (places, objects) is integrated as part of the game, combining it with the virtual world;
- The idea of “Games coming back to real-world”, which suggests that computer games are the dominant form of gaming, and pervasive games appear as an alternative to this scenario.

A common term that arises in pervasive gaming discussion is “mixed-reality game”, which denotes the characteristic of the game integrating the virtual and physical domains. In general, authors consider those terms as synonyms, with exceptions as noted by (Magerkurth *et al.* 2005).

3.2.1 Cultural approaches

Montola and co-authors (2009) defined a pervasive game as “*a game that has one or more salient features that expand the contractual magic circle⁴³ of play socially, spatially or temporally*”. Another example comes from Peitz and co-authors (2007), who stated that “*pervasive signifies that the gameplay is pervasive*”.

The work by Montola and co-authors (2009) has been influenced by the research findings of the IPerG (Integrated Project on Pervasive Gaming) project (2008), a European research project dedicated to pervasive games that spanned from 2004 to 2008.

In the definition by Montola and co-authors (2009), the spatial expansion indicates that the game no more has a specific place to occur, the game now may happen anywhere. The boundaries of the play space become not well defined, or undefined. It is a metaphor for “the world as a playground”. The temporal expansion indicates that the concept of “game session” is not well defined: now the game may be blended with everyday activities. This relates to the idea of a process that exists in parallel to the “real life”, and may require player attention any-time. The social expansion obscures the definition of players and non-players. The players may take part in a game not knowing in advance who the other players are. Another possibility could be non-players participating in the game unintentionally, as in *Insectopia* (Peitz *et al.* 2007), that uses nearby Bluetooth devices (*e.g.* mobile phones, printers) to generate the game content. The owners of those devices have no idea that they are “being part” of a game. Another example of this expansion might be of a game happening on some place and by-passers joining the game to experience it.

The definition that Montola and co-authors (2009) propose is very broad, encompassing simple mobile phone games to “artistic events” with complex infrastructure⁴⁴. According to this definition, games may or may not use technology, in

43 The “magic circle” is an important concept in games. Please see Section 2.2.1 for more information.

44 As pervasive game examples for this: *Can you see me now?* (Benford *et al.* 2006a) and *Uncle Roy all around you* (Benford *et al.* 2004a).

other words, technology⁴⁵ is not a requirement. Montola and co-authors (2009) defined two categories to classify pervasive games that use technology – “*technology-supported games*” and “*technology-sustained games*”.

In technology-supported games, the technology acts as a complement to the game. For example, technology may work as a mere tool (*e.g.* players using mobile devices to make calls) or as some physical object that has a specific role in the game, which players can go after or manipulate.

In technology-sustained, the technology is of central importance to the game. Without using the technology, the game does not exist. In this case, technology shapes the game completely⁴⁶. This relates to the technology-based definitions by other authors (as in Section 3.2.2).

Davies and co-authors (2007) also present pervasive games as expanding the magic circle, although their discussion focuses on the physical expansion only.

Jane McGonigal (2003; 2006) proposes different definitions for pervasive games, by basing them on cultural aspects, theater, and technology. She proposes a broad domain of “pervasive play and performance”, with three categories: ubicomp games, pervasive games, and ubiquitous games.

McGonigal (2003) defines “pervasive play” as “consisting of 'mixed reality' games that use mobile, ubiquitous and embedded digital technologies to create virtual playing fields in everyday spaces”. The “performance” aspect, she argues, is that players can maximize their play experience by performing instead of just participating in the game, thus becoming “game actors”.

In her classification, “pervasive games” are “*performance-based interventions that use game imagery to disrupt the normative conventions of public spaces and private technologies*” (McGonigal 2006). In this case, “ubicomp games” are advanced game prototypes (possibly with custom hardware) for research into new ubiquitous computing technologies. Finally, in her framework, “ubiquitous games” are commercial entertainment projects that bring computer games objects/activities to the real-world.

45 Electronic, computing devices and peripherals.

46 For example, games based on location using GPS sensors.

3.2.1.1

A note on alternate reality games

Although this research work does not focus in alternate reality games (ARGs)⁴⁷, we think it is important to introduce this subject as it is related to the origins of pervasive games for historical purposes. Some authors from game studies, as (Montola *et al.* 2006; Montola *et al.* 2009; McGonigal 2006), consider “alternate reality games” as part of the “pervasive games” spectrum.

ARGs suggest a surrealistic setting where the game denies its existence “as a game”. The main slogan of those games is “this is not a game”. It uses the real-world as a platform and creates a comprehensive interactive narrative, like massive puzzles that span on different media, like web-sites, emails, and phone calls. Game masters create (real-world and virtual) content and steer the story according to players’ reactions. The game is purposely ambiguous, so that players always question if the game activities are indeed part of the game, or part of real-world life. This includes entering the game and guessing if it is over.

For example, in 2001 Microsoft unveiled the game *The Beast* (42 Entertainment 2007; Szulborski 2007) as a marketing campaign for the movie *A.I. Artificial Intelligence* (Spielberg 2001). The game began with a question, “Who killed Evan Chan”, and then evolved to an interactive story that had been deployed over the internet and the real world. The game itself was not advertised as a game, and its entry-point was hidden in *A.I.* movie trailers and posters⁴⁸ (see fictional credit “Jeanina Salla” as the “Sentient Machine Therapist” in Figure 3.1)⁴⁹.

After following the clues (like searching for Jeanine Salla on the internet), the player could access “real-world elements” (like voice mails from the game) that opened-up the gate for the storyline. The game designers have created fake websites and other multimedia content to support the game through puzzles and

47 In Chapter 4, we define a criteria for what kinds of games we will consider in this research work – ARGs are not included.

48 Montola and co-authors (2009) report other clues hidden in the posters. On some posters, there was a hidden phone number. When calling this number, there was a voice message from the game. On the back of some posters, there were some marked letters. When assembling the letters, two sentences could be formed: “Jeanine was the key” and “Evan Chan was murdered”.

49 Figure extracted from http://www.impawards.com/2001/ai_artificial_intelligence_ver5_x1-g.html in a basis of fair use policy.

other interactions. Also, sometimes the game would make phone calls to the players.



Figure 3.1: Hidden clue for the game in an *A.I.* movie poster

Another important (and pioneering) example of ARG is *Majestic* (Wikipedia 2011b), a commercial game by Electronic Arts from 2002. Despite its importance (as a pioneering project), this game was a commercial failure (Montola *et al.* 2009).

Considering the game studies perspective, it makes sense to consider ARGs as pervasive games. However, this is up to debate, especially considering researches from technological perspectives that consider pervasive games as forming mixed-realities, as (Hinske *et al.* 2007).

Other researchers (McGonigal 2006) use the term “immersive game” to refer to ARGs.

3.2.2 Technological approaches

Technological approaches place more emphasis on the underlying technological aspects needed to realize pervasive games. There is a variety of definitions, but they form two broad groups:

- As applications of pervasive/ubiquitous computing, or context-aware applications.
- “Computer-augmented” games.

The following sub-sections analyze these two groups.

3.2.2.1 Computer-augmented games

The vision of “computer-augmented” games considers the notion of existing real-world (physical) games⁵⁰ being “upgraded” with some sort of computing. The difference to the “games as pervasive computing applications” approach is subtle. Schneider and Kortuem (2001) also share this concern (emphasis added):

“We define a Pervasive Game as a live-action role playing *game that is augmented with computing and communication technology in a way that combines the physical and digital space together*. In a Pervasive Game, the technology is not the focus of the game but rather the technology supports the game. Although technology is ubiquitous in a Pervasive Game, its role is a supporting one and thus the technology is kept as unobtrusive as possible”.

This definition by Scheiner and Kortuem (2001) is probably one of the first attempts at coining a definition for pervasive games, and it shares some similarities with Montola and co-authors' definition (2009) when regarding the role of technology in pervasive games.

Other authors like Magerkurth and co-authors (2005) have followed the idea (emphasis added):

“an emerging genre in which traditional, *real-world games are augmented with computing functionality*, or, depending on the perspective, purely virtual computer entertainment is brought back to the real world”.

Magerkurth and co-authors (2005) go further in this regard and consider as pervasive games what they categorized as: smart toys, affective gaming, augmented table-top games, and augmented reality games. Smart toys are traditional children toys fitted with sensors that enable computing. Affective gaming deals with using emotions and physiology as game inputs. Augmented table-top games are traditional board games equipped with touch-screens, sensors, and tangible objects. Tangible objects are manipulable physical objects possessing computing properties. Augmented reality games draw virtual content over the real-world, using special glasses, helmets, or mobile devices (as virtual windows), for example.

We consider the “computer-augmented game” vision broader than the ones based on pervasive and ubiquitous computing concepts.

50 An example of “real-world, physical game” would be “Capture the flag” (Wikipedia 2011a).

3.2.2.2

Pervasive computing, sensors, and related topics

Several researchers relate pervasive games with topics as pervasive computing, sensors, and context-aware applications.

One of the first games to define itself as “based on ubiquitous computing”, or “aiming at constructing a context-aware experience” was *Pirates!* (Björk *et al.* 2001), back in 2001. Later, researchers related to the *Pirates!* project have decided to coin the term “ubiquitous games”, because “they explore the possibility of taking the functionalities that ubiquitous computing offers and applying them to computer games” (Björk *et al.* 2002).

Linner and co-authors (2005) view pervasive gaming through a related lens, regarding them as “*applications interweaved into the real world, an emerging field for context-aware multimedia applications*”.

The focus on sensors, wireless networking, and mobility motivates the definition for several researchers. For example, Capra and co-authors (2005) define pervasive games as extension of traditional computer games through those technological means:

“Through a combination of personal devices, positioning systems and other multimedia sensors, combined with wireless networking, a pervasive game can respond to a player’s movements and context and enable them to communicate with a game server and other players.”

Benford and co-authors (2005) share a similar view by declaring that what characterizes pervasive games in a unique way is the combination of pervasive computing technologies with the public nature of playing in those games.

Hinske and co-authors (2007) present another definition with focus on pervasive computing, but more concerned in incorporating elements from game studies:

“Pervasive Games are a ludic form of mixed reality entertainment with goals, rules, competition, and attacks, based on the utilization of Mobile Computing and/or Pervasive Computing technologies”.

3.2.2.3 Other technological views

Walther (2005) considers pervasive games as a system that exists in a space that presents four characteristics: distribution (embedded computing, ubiquitous infra-structure), mobility, persistence (“always-on” availability), and “transmedi-ality” (ways to consume media, media production by users). He presents then a rather abstract definition of pervasive games:

“Pervasive gaming implies the construction and enacting of augmented and/or embedded game worlds that reside on the threshold between tangible and immaterial space, which may further include adaptronics, embedded software, and information systems in order to facilitate a ‘natural’ environment for gameplay that ensures the explicitness of computational procedures in a post-screen setting.”

3.3 Pervasive games genres

Although this research work does not focus on categorizing pervasive games, this section explores some categorization attempts found in the literature, as genre⁵¹ classification for pervasive games might bring some confusion.

This section explores the research works by Walther (2005), Magerkurth and co-authors (2005), Montola and co-authors (2006)⁵², and Montola and co-authors (2009)⁵³. The works by Walther (2005) and Magerkurth and co-authors (2005) stem from a technological viewpoint, while the works by Montola and co-authors (2006) and Montola and co-authors (2009) stem from a cultural viewpoint. The remainder of this section explores those works individually.

3.3.1 Walther (2005)

Walther (2005) considers pervasive games as encompassing these sub-genres: mobile games, location-based games, ubiquitous game, virtual reality games, augmented reality games (or mixed-reality games), adaptronic games.

51 We consider in this section “game genres” and “game types” as synonyms.

52 The authors are Montola, Waern, and Nieuwdorp.

53 The authors are Montola, Stenros and Waern.

He considers location-based games as games that include position/location in the game rules. Mobile games are the ones where changing location is an important element in the gameplay. He defines ubiquitous games as “*games that the computational and communications infrastructure embedded within our everyday lives*”. Virtual reality games are like traditional computer games. Augmented reality games (or mixed-reality) are the ones that combine virtual and physical worlds. Adaptronic games use real-world information to influence gameplay. For example, weather and stock market information.

3.3.2 Magerkurth and co-authors (2005)

As we discussed in Section 3.2.2, Magerkurth and co-authors (2005) suggest smart toys, affective gaming, augmented tabletop games, location-aware games and augmented reality games as pervasive game genres.

3.3.3 Montola, Waern, and Nieuwdorp (2006)

Montola, Waern, and Nieuwdorp (2006) suggest the following genres: alternate reality games, massively multi-player mobile games, pervasive live-action role-playing game, online-onstreet games, proximity games, event games, cross-media games.

Alternate reality games (ARGs) are discussed in Section 3.2.1.

Massively multi-player mobile games involve moving around physical spaces interacting with people and (virtual or physical) objects. Usually those games have a persistent world⁵⁴.

A pervasive live-action role-playing game (LARP) is a real-world RPG that has been expanded according to Montola and co-authors' (2009) definition of pervasive games⁵⁵. Schneider and Kortuem (2001) also refer to this category in their definition of pervasive games.

54 See Section 5.1.15.

55 See Section 3.2.1.

Online-onstreet games are the ones played in the virtual and physical worlds simultaneously. They often create a mixed-reality where players from both realms interact.

Proximity games are the ones that make use of sensor technologies to create local ad-hoc games. For example, these games can use Bluetooth, RFID (radio-frequency identification) and NFC (near-field communication) technologies.

Event games are games that occur in a particular time and physical place⁵⁶, generally conceived this way to optimize the game experience while avoid/managing problems related to technology limitations.

Cross-media games are the ones played across different devices at the same time, offering different modes of participation⁵⁷. This is not to be confused with portability, or availability on multiple platforms. For example, cross-media games may combine different media as TVs, web, mobile phones, and desktop computers. It is not uncommon on those games that each device has a different role (and applicability) in the gameplay.

3.3.4 Montola, Stenros, and Waern (2009)

Montola, Stenros, and Waern (2009) try to take a broader view on pervasive game genres, including items that have been greatly influenced by the game studies view. Their list of genres is: Treasure hunts, assassination games, pervasive LARPs, alternate reality games, smart street sports, playful public performance, urban adventure games, and reality games.

Alternate reality games and pervasive LARPs are the same as in the previous section. Also, “playful public performance” is equivalent to “event games” from previous section.

In “treasure hunt games”, players have to find (physical or virtual) objects hidden in the real-world, on a possibly very vast physical space. Assassination games are games inspired on the ideas of the science fiction movie *La Decima Vittima* (Montola *et al.* 2009).

⁵⁶ As an example of “a game happening in a particular time and place”, consider a soccer match.

⁵⁷ See Section 5.1.9 and Appendix B.9.

Smart street sports are games played on urban areas that require physical exercising and strategy thinking, like tag games augmented with technology.

Urban adventure games combine storytelling and puzzle solving in urban areas. An example would be a game designed for tourists.

Finally “reality games” seem to be similar to the idea of ARGs, playing with the notions of “real” and “reality”.

3.4

Pervasive games in this research work

This research work is concerned with defining a methodology for designing activities in pervasive games⁵⁸. This methodology is mainly concerned with Software Engineering issues, but it also presents aspects that may influence traditional game design. In this sense, the viewpoint of this research work is technological.

This research work does not propose another formal definition for pervasive games. However, regarding the goals of the methodology that this research work proposes, we consider the definition⁵⁹ by Hinske and co-authors (2007) the one that shares concerns with what we are proposing – something that binds traditional game concepts with computing/technology aspects. For example, the definition by Hinske and co-authors (2007) directly uses concepts as “goals”, “rules”, “competition”, “attacks” from general game studies, while relating to technological concepts as “mixed-reality” and “pervasive computing”. This is different from stating simply that a pervasive game is an application of pervasive computing technologies – in this case, their definition also includes general game concepts.

From the definitions in the cultural spectrum, the one that we consider as closest to our concerns is the one by Montola and co-authors (2009). However, we consider pervasive games as being based on technological aspects⁶⁰. For example, Chapter 5 presents characteristics that we found relevant in pervasive games after studying several projects and the literature. The reader may notice that they are technology-biased.

58 Chapter 4 presents an overview of our methodology.

59 Among the ones more inclined to technology issues and pervasive computing.

60 See our boundary criteria for pervasive mobile games in Section 4.2.

Our viewpoint relates to cultural approaches as the proposed methodology has aspects that may influence the overall game design, as the pervasive game features and perspectives⁶¹. Also, we present an “enhanced game design document template”, which corresponds to a traditional game design document augmented with items provided by our methodology. Those items correspond to analysis of important features found in pervasive games, and the specification of game activities, which is part of a Software Engineering process. Chapters 5 to 7 detail those items provided by our methodology.

3.5 Summary

In this chapter, we have introduced the field of pervasive games. This field is rather young, and the definition of the main concepts is still up to debate. As games are a multidisciplinary field, researchers from several backgrounds have tried to define pervasive games, producing technological and cultural approaches. The end result is that there are a lot of definitions for pervasive games, some of them presenting conflicting ideas, which brings a lot of confusion in this research area.

Although this research work is not concerned with pervasive game genres, this chapter explored some genre classification attempts found in the literature, which is also another confused area.

The chapter ends with a discussion on how this research work relates to pervasive games.

61 Chapter 5 details this subject.