

## 2 Games

This chapter presents an overview on games on a general level, as a preparation to the definition, theory and methods used by pervasive games. Pervasive games are the subject of Chapter 3.

Section 2.1 provides a discussion for some definitions of play and games in a general level, not regarding issues specific to computer games<sup>18</sup>. Section 2.2 discusses some game concepts that are important for this research work, as a background. Section 2.3 presents some considerations specific to computer games. Section 2.4 provides an overview on game design and Section 2.5 discusses how game design relates to our methodology. Finally, Section 2.7 presents the first part of our case study – the general game design of *Pervasive Word Search*.

### 2.1 Games and play

The activity of playing is as old as human culture. In game studies<sup>19</sup>, this activity is simply referred as “play”.

Play has been the subject of study of people from several backgrounds, as sociologists, anthropologists, psychologists, designers, computer scientists, and game practitioners. Hence, the study of play and games is a multidisciplinary area – it requires insights from several (apparently) unrelated areas.

Play and games are related concepts, but their relationship is complex. For example, Salen and Zimmerman (2004) demonstrate that in some contexts, play is viewed as a component of the game, and in others, it is the opposite.

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18 This research work considers “computer games” and “digital games” as synonyms. The term “computer” is used as an umbrella term for “computing devices” such as desktop computers, mobile phones and video-games.

19 This section discusses aspects of play and games that are relevant for this research work. For example, we are not concerned with gambling and related types of “games”.

The anthropologist Johann Huizinga is considered the first researcher in game and play studies. In his book *Homo Ludens*<sup>20</sup> (1971), which is considered a seminal reference in this area, Huizinga defined “play” as (emphasis added):

“a free activity standing quite consciously *outside "ordinary" life* as being “*not serious*”, but at the same time *absorbing the player intensely and utterly*. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its *own proper boundaries of time and space* according to *fixed rules* and in an orderly manner. It promotes the *formation of social groupings* which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means.”

In the previous definition, we have highlighted concepts that appear in other definitions for games presented in this section.

Another famous reference for play and games is the sociologist Roger Caillois (2001), who defined “play” as “*an activity which is essentially: Free (voluntary), separate (in time and space), uncertain, unproductive, governed by rules, make-believe*”.

The “separate” aspect in this definition relates to play as having a specific time and physical place to happen<sup>21</sup>. The “unproductive” aspect relates to “not producing artifacts, goods, products”, and “make-believe” refers to “creating a second reality where the play activity lives”. This latter aspect relates to the concept of the “game world” as being “a separated world from the everyday world”.

Defining games has been the subject of many works. Table 2.1 lists some definitions for games, highlighting some common concepts that appear in the definitions. We included definitions that are considered relevant in the area of game studies and game design.

20 Besides the ability to think (*Homo Sapiens = Man the Wise = Knowing man = Man who Knows*) and to build things (*Homo Faber = Man the Maker = Fabricating Man = Man who builds*), Huizinga refers to the Man who Plays, the Ludic Man (*Homo Ludens = Man the Player = Playing Man*).

21 As an example, a soccer match that happens at a specific time and location (soccer pitch).

Author	Definition
Chris Crawford (1984)	“I perceive four common factors: representation [“a <i>closed formal system</i> that subjectively represents a subset of reality”], <i>interaction</i> , <i>conflict</i> , and <i>safety</i> [“the results of a game are always less harsh than the situations the game models”] ”
Jesper Juul (2003)	“A game is a <i>rule-based formal system</i> with a <i>variable and quantifiable outcome</i> , where different outcomes are assigned different values, the <i>player exerts effort</i> in order to <i>influence the outcome</i> , the player feels <i>attached to the outcome</i> , and the <i>consequences</i> of the activity are <i>optional and negotiable</i> .”
Rollings and Adams (2003)	“A game takes place in an <i>artificial universe</i> that is governed by <i>rules</i> . The rules define the <i>actions</i> or <i>moves</i> that the players may make in the game, and also the actions that they may not make. ...  ... The <i>rules</i> also define the obstacles, or <i>challenges</i> , that the players must overcome to win the game. The challenges, together with the actions the players can take to meet them, make up the <i>gameplay</i> .”
Salen and Zimmerman (2004)	“A game is a system in which players engage in an <i>artificial conflict</i> defined by <i>rules</i> , that results in a <i>quantifiable outcome</i> ”
Ernest Adams (2010)	“A game is a type of <i>play activity</i> , conducted in the context of <i>pretended reality</i> , in which the participant(s) try to <i>achieve at least one</i> arbitrary, <i>non-trivial goal</i> by acting in accordance with <i>rules</i> ”

**Table 2.1: Some definitions for games (emphasis added)**

Table 2.2 lists how the common concepts appear (*e.g.* the wording) in selected game definitions present in Table 2.1.

Concept	How the concept appears in selected definitions
Rules	Formal closed system, rule-base formal system, moves, rules
Goals	Conflicts, goals
Challenges	Conflicts, “influence the outcomes”, exert effort, attached to the outcome, achieve a non-trivial goal
Results	Outcomes, variable and quantifiable outcome
(Social) interaction	Interaction
Artificial world	Pretended reality, safety, optional consequences, artificial conflict

**Table 2.2: Common concepts in game definitions and how the common concept appears in selected game definitions**

Players engage in challenges hoping to influence the result, and then win the game (or the opponents). Pure play (or “ludic activity”) seems to be like games with less rigid (or formal) structure (like rules).

Among the definitions in Table 2.1, we consider the definition by Juul (2003) as the most complete one. However, this research work follows the defini-

tion by Adams (2010) for defining a game in the general level, because it is more concise and practical. However, it is important to remark that this research work is concerned with pervasive games, which have aspects that question some traditional game concepts<sup>22</sup>.

## 2.2 Important game concepts

This section presents game concepts that are important in this research work, as they are either referenced later or serve as basis for other discussions, such as: the magic circle, gameplay, game rules, game state, and game experience.

### 2.2.1 The magic circle

An important concept found in games literature is the “magic circle”, which some pervasive game definitions refer to. Salen and Zimmerman (2004) have developed the concept of magic circle based on the works of Huizinga (1971).

The magic circle is a combination of physical space, time, conventions and psychological state of mind that is related to how games are played. The magic circle defines a *frame* – a previously demarcated time and physical space (the game space) where the game happens. When players enter this frame, they know (consciously or not) that they are *playing* – that now they are in a special “world” governed by the rules of the game. Some games formally demarcate the physical game space, like a soccer or basketball court, or a chess board, but this is not the case for all games, where the game space is demarcated metaphorically (like “tag games”<sup>23</sup>). This notion suggests that games have fixed time and physical places to happen, which is something that pervasive games question.

This artificial world that the magic circle creates also works as a social contract for the players, meaning that they agree to surrender ordinary reality to live the separate reality of the game. This also includes players agreeing to be limited by the game rules, in order to enjoy the game. Salen and Zimmerman (2004)

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22 For example, the concept of “magic circle” (Section 2.2.1). Chapter 3 discusses this subject.

23 Please refer to (Wikipedia 2011d) for more information on “tag games”.

define this state of mind as the “lusory attitude”, which is also referred as “suspension of disbelief”.

Pervasive games question the notion of the magic circle. For example, some definitions (see Chapter 3) are based the magic circle being expanded in time, space and social dimensions.

### 2.2.2 Gameplay

Adams (2010) defines *gameplay* as a concept consisting of two parts:

- “the *challenges* that a player must face to arrive at the object of the game”
- “the *actions* that the player is permitted to take to address those challenges”

Challenges and actions form the core of gameplay. The rules of the game define which actions are allowed, and which are not.

### 2.2.3 Game rules

Rules are a major element that differentiates games from “pure play” or “pure ludic activities”. Rules are an important part of gameplay as they define which actions are permitted in the game. Also, rules define the game goals and also how the game ends – the victory condition.

Rules define the formal structure of a game (Salen and Zimmerman 2004). Salen and Zimmerman (2004) identify some general characteristics of game rules, such as: “*rules limit player action*”, “*rules are explicit and unambiguous*”, “*rules are shared by all players*”, “*rules are fixed*”, “*rules are binding*”<sup>24</sup>, and “*rules are repeatable*”.

The characteristic of “rules being repeatable” is very interesting for computer games, as this makes it possible to write computer software for simulating a game.

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<sup>24</sup> Salen and Zimmerman (2004) explains this as “rules are meant to be followed”, being enforced by an authority (the game referee).

#### 2.2.4 Game state

Salen and Zimmerman (2004) define “game state” as “the current condition of the game at any given moment”. This means that the game state is a static “snapshot” of data that characterizes the game. For example, in soccer some game state elements could be which half is being played, the remaining game time, team information<sup>25</sup>, current score, and current weather conditions. We refer to the “game state” in Section 6.3.

#### 2.2.5 Game experience

The first part of our methodology is concerned with identifying certain aspects<sup>26</sup> in pervasive games that may affect the game experience. For this reason, this section presents an overview for this concept.

Game experience relates to the experience of playing a game. Calvillo-Gómez and co-authors (2010) define “experience” as: *“both the process and outcome of the interaction of a user with the environment at a given time”*. Calvillo-Gómez and co-authors (2010) presented this concept in the context of video-games<sup>27</sup>. The game experience involves aspects as “fun”, immersion, learning, flow<sup>28</sup>, and engagement (Cowley *et al.* 2008). The concept of presence (next subsection) also takes part in game experience (Cowley *et al.* 2008; Calvillo-Gómez *et al.* 2010), so as does immersion.

##### 2.2.5.1 Presence and immersion

Presence is a key for the experience of playing. It is the perception of being in a particular space or place. Presence has been studied from different perspect-

25 Some elements of team information could be the team name, number of players in the field, player names, numbers and location in the field.

26 The pervasive game features and perspectives, discussed in Chapter 5.

27 They already had issues of digital games in mind.

28 Flow is a state of effortless concentration and enjoyment where the person is fully immersed in an activity, operating at full potential. This concept has been defined by Mihaly Csikszentmihalyi. For more information on flow, please refer to (Csikszentmihalyi 1990).

ives (Bystrom *et al.* 1999; Lombard and Ditton 1997; Witmer and Singer 1998; Slater and Wilbur 1997), but most of the approaches are related to the sensorial experience of users in general-purpose virtual environments. Presence also relates to social aspects as “social presence” (being part of a group or community). However, specific research on presence in games is scarce (Ravaja *et al.* 2006).

This concept also relates to immersion, which is a component of games and play, as Huizinga (1949) has referred to as “*activities absorbing the player intensely and utterly*”. However, “immersion” and “presence” are difficult terms to define and often used as synonymous. We prefer to understand immersion as a result of the mechanisms that transport the user to the virtual world. This is a position clearly aligned with the ideas by Slater and Wilbur (1997)<sup>29</sup>. In this case, computer games try to simulate presence through building and presenting virtual worlds. Pervasive games, as we shall see in Chapter 3, extend this concept to a mixed reality environment (a combination of the virtual and physical worlds).

Presence and immersion are implied consequences of the magic circle and the game experience. The challenge for digital (and pervasive) games is to manage the game experience in a certain way that does not break the illusion of being in a game.

## 2.3 Computers and games

Computer games are the prominent form of gaming nowadays. In fact, computers act as a medium for realizing games of several kinds. There are some interesting statistics from 2010 that the ESA (Entertainment Software Association) provided regarding the USA digital game market (ESA 2011):

- Game software and hardware sales generated \$25.1 billion dollars;
- 72% of US homes have computer or video-games;
- 55% of players play games on mobile phones or portable devices;
- 42% of players are women;
- The average player is 37 years old and has been playing for 12 years.

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<sup>29</sup> We encourage the reader to analyze the discussions on immersion and presence found in Slater (1999), Sas (2005) and Retaux (2003).

Juul (2003) suggests that computers are enablers for games because games have well-defined rules that make it possible to create computer software based on them. In fact, computers work as mediators for players, by acting as referees for the game rules.

In the case of computer games, Juul also notices the difference between game implementations and game adaptations. A game implementation (or realization) is an exact mapping of all possible game states (and rules) to a computer program. This is the example of chess. On the other hand, a game adaptation is the case where some rules or game states cannot be mapped directly in a computer program. An example would be a basketball game. In this example, the computer program is a simplified model of the real-world, as it is necessary to have tradeoffs among computing capacity (*i.e.* for physical models, implementing non-player characters), game interfaces<sup>30</sup>, game rules, and game states.

In this regard, it is often necessary to build simplified models of the real-world for computer games, which represents a vast test-bed for applying knowledge of different Computer Science areas<sup>31</sup> in the same project. However, maybe due to the playful (and “not serious”) nature of games, research on computer games is in many cases underrated.

Non-digital games focus on the physical world, physical objects, players and their interpersonal interactions. In this sense, social interactions play an important role in non-digital games. On the other hand, computer games have placed great emphasis on enhancing game simulation (the virtual worlds), while social aspects being often neglected. Although multi-player games are popular, they are often played through a network, with computers acting as mediators. In other words, players do not have direct contact. Often, this has helped to stereotype gamers (as being anti-social people) and gaming into a niche (and marginalized) activity. Pervasive games may help in changing this view due to their characteristic of integrating the physical world into the game, thus making players go out in the streets and (possibly) interacting directly with other players.

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<sup>30</sup> For example, player bodies and the ball are not part of the computer interface.

<sup>31</sup> Examples: Computer Graphics, Artificial Intelligence, Mobile Computing, Networking, Physics simulations, Human-computer interaction.



## 2.4 Game design

Game design is a fuzzy concept and as such, there is not a final definition for it. For example, Adams (2010) defines game design as a process consisting of: *“imagining a game, defining the way it works, describing the elements that make up the game (conceptual, functional, artistic, and others), and transmitting that in-formation to the team that will build the game”*.

Another example comes from Salen and Zimmerman (2004), who define game design as *“the process by which a designer creates a context to be encountered by a participant, from which meaning emerges”*. Their definition is very abstract as they try to cover many possibilities<sup>32</sup>.

The definition by Adams (2010) suggests that game design is something that is part of a bigger process (e.g. the part that says *“transmitting that information to the team that will build the game”*). The reason for this is that Adams is more concerned with computer games. By contrast, the definition by Salen and Zimmerman (2004) is more abstract – the process could finish once the designer *“creates a context to be encountered by a participant”*.

Some notable game designers, as Chris Crawford, consider game design as some work of art. For example, Crawford (1984) once wrote that *“game design is primarily an artistic process, but it is also a technical process”*. He continued acknowledging that game design is a very complex process to be formalized, and that formalization of game design would be prejudicial to this inherent creative process (Crawford 1984). In a later work (Crawford 2003), Crawford confirmed his holistic view on game design considering it as *“a soft, fuzzy concept involving a great deal of expertise, some rules of thumb, and strong intuition”*.

It is important to notice that traditional game design is a process that aims at creating the game concept only<sup>33</sup>. When it comes to computer game design, it is

32 In summary, Salen and Zimmerman (2004) say that a *“designer”* is who creates the game (e.g. game designer or team of people), context corresponds to *“spaces, objects, narratives, behaviors”*, participants are the players who manipulate context through play, and meaning is *“the result of players taking actions in the course of play”*.

33 For example, story, narrative, and other elements as in Table 2.2.

also necessary to include elements that address the use of computers, as user interface design and human-computer interaction issues.

However, when considering building computer games, game design is part of a bigger process that includes creating the software artifact that realizes the game in a computer. This second part, which includes software design and implementation, is governed by Software Engineering methods and techniques.

## 2.5

### Game design and the methodology proposed in this work

This research work is concerned with pervasive games, which are the subject of Chapter 3. We consider the process of building a pervasive game as having three general parts: game design, software design, and software implementation.

This research work proposes a methodology<sup>34</sup> that concerns aspects related to *software design* – the second part of the process. With this in mind, we consider as “game design” a process as discussed in Section 2.4.

However, our methodology provides elements that can be used in the game design process for pervasive games. This is the case of the first part of our methodology, the domain mapping – through the concepts of pervasive game features and perspectives. The pervasive game features represent prominent aspects that appear in pervasive games. In this sense, the pervasive game features can be used by game designers to spark novel game and design ideas.

The second part of our methodology is concerned with the software part of pervasive games – it provides elements to design activities in pervasive games. In this research work, an activity represents a set of actions involving players, (mobile) devices, sensors and actuators to reach some goal in the game. Although this part concerns the software design, it is obviously affected by decisions of game design.

This research work provides an enhanced game design document template, which corresponds to a document based on a traditional game design document, but augmented with elements provided by our methodology. For example, it includes sections for analysis on how pervasive game features should (or not) ap-

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<sup>34</sup> Chapter 4 presents an overview of the proposed methodology.

pear in the game design, and also the specification (design) of game activities (the part concerned with software issues). This template has been inspired by the game design templates of the IPerG project (2008), a European project dedicated to studying pervasive games that spanned from 2004 to 2008. Appendix D presents the complete template.

## 2.6

### Game design example

This section presents the first part of our case study – the general game design of *Pervasive Word Search*. It uses elements defined in the game design document template present in Appendix D.

#### 2.6.1

##### Introduction

*Pervasive Word Search* is a single-player pervasive mobile game where the player receives a word and has to search for its letters in the physical (real) world. The selected word is part of a word database for the game.

The player has three sources of letters: colors, WiFi network names, and Bluetooth device names. The player has a limited time to find all the letters of the word. If the time runs out, the player loses the game. The game may be restarted with another word.

#### 2.6.2

##### Game design overview

These are the research goals of this project:

- Experiment with all possible sensors available on mobile phone devices;
- Experiment with a pervasive mobile game where the source of content relies in the real world: colors, letters, wireless networks;

- Stimulate players to explore the environment that is around them. In particular, to stimulate people to go to places where potentially there are wireless networks, and groups of people with mobile devices;
- Investigate how people react to this non-conventional approach to content sources (build words with letters that come from color names);
- Investigate if using the camera as content source may cause embarrassing situations for players, or inhibit them in some way;
- Implement an application that use the various available sensors (in smart-phones) to collect context information;
- Integrate the camera using Qt.

#### **2.6.2.1**

##### **Game setting**

*Pervasive Word Search* can be played anywhere. Some gameplay features stimulate players to go to areas where there are groups of people, with mobile phones.

#### **2.6.2.2**

##### **Target platform and tools**

The target platform is Nokia Symbian. The implementation should be based on Qt and the QBluetooth<sup>35</sup> library (for Bluetooth support).

#### **2.6.2.3**

##### **Genre**

Virtual treasure hunt (considering that letters are the “treasure”).

#### **2.6.2.4**

##### **Target audience**

Causal players.

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<sup>35</sup> Please refer to (Valente and Ftylitakis 2011) for more information on this library.

### 2.6.2.5 Gameplay

*Pervasive Word Search* is a single-player pervasive mobile game for mobile phones where the goal is to find the letters from a word the game draws. The game setting is the real world. To find the letters, the player must explore the environment surrounding him. While exploring the physical world, the player may interact with some game zones – the dark, open, and wireless zones. The “dark zone” is a place with “low” ambient light. An “open zone” corresponds to an outdoor area. A wireless zone corresponds to a place with a certain number of WiFi access points and Bluetooth devices. Interacting with these zones is an important part of this game.

The player is able to get letters by capturing colors and interacting with the wireless and dark zones.

The game displays on the screen the real world as seen by the device camera. Players use this tool to capture colors in the real world. When a color is captured, the game extracts the letters that form the color name, and uses those colors to eliminate words from the drawn word<sup>36</sup>. Those colors have an expiry time. When this time expires, the color “dies” and the player will have to capture it again. When the player capture the same color several times, this color expiry time gets added up. Currently, the expiry time is 60 seconds. What are those colors? The game defines a basic set of colors:

- red                      • yellow                      • orange                      • green                      • purple
- blue                      • pink                      • black                      • white                      • gray

When looking at those names, there are some letters (from the alphabet) that are missing. To get those missing letters (named in the game as “wireless letter set”), the player has to explore the real world and find wireless zones (*i.e.* a place with Bluetooth devices and WiFi access points). The game uses the Bluetooth device names and WiFi network names to extract the letters that are not possible to get from color names. The game searches for wireless zones automatically as

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<sup>36</sup> The words and color names come from the same language. In this example, the language is English.

the player walks in the environment. The letters obtainable from the wireless zone are said to form a “wireless letter set” in this game. The language that the game uses determines the actual members of this wireless letter set. Also, when the player enters a “wireless zone” the game clock may start to run slower, depending on the number of Bluetooth-enabled mobile phones around (four or more in the current specification).

The player has to search for letters until he finds all of them. There is a limited time to accomplish this. The clock decreases until it reaches zero.

When the player enters a “dark zone” (a place with low light), he earns “white” and “gray” automatically, and those colors remain live as long as he stays in the dark zone.

When the player enters an “open zone” (an outdoor area), the game clock starts to run faster, which remains until the player leaves the open zone. The letters also die faster.

#### **2.6.2.6 Game session**

Each game session has a pre-defined time, and for each session there is a new word. The game must find all the letters of the word before the game time expires.

#### **2.6.2.7 Main features**

- Potentially educational pervasive mobile game, using colors and names;
- Explores various situations in the real world that can be sensed with mobile phone sensors;
- Encourages players to play in areas with groups of people, because parts of the game content derive from the presence of other mobile phones.

#### **2.6.2.8 Game modes**

Single-player.

#### **2.6.2.9 Game goals**

Find letters to build the word the game selects, exploring the physical/real world.

#### **2.6.2.10 Game environment**

Physical/real world.

#### **2.6.2.11 Story**

N/A.

#### **2.6.2.12 Visual theme**

Not defined yet. Using prototypical interface.

#### **2.6.3 Game flow**

After running the game application, the player accesses the initial screen to start a game session. When starting a session, the game draws a word and starts the game clock. From this moment the player has to explore the environment.

### **2.6.3.1**

#### **Typical game situation**

The player starts walking in the environment capturing colors that provide the required letters, using the camera to focus the object of interest.

In the background, the game searches for Bluetooth and WiFi networks, extracting the letters that cannot be obtained from colors. The game informs the player when it finds or loses those letters (those letters are lost if the devices fall out of range).

The game also informs the players when he enters one of the game zones: wireless zones, dark zones, open zones.

### **2.6.3.2**

#### **Social interference**

Playing the game may catch attention from people nearby, as the players needs to point the camera and capture color. For an outsider, it may look as the players are taking photos. It is necessary to research the impact of this, if it might make players or outsiders embarrassed, or if it might inhibit people from playing the game.

The game captures the other letters (“wireless letter set”) silently. It does not contact other people in this process.

### **2.6.3.3**

#### **Game pacing**

The game has a dynamic pacing, as it is necessary to walk in search for the letters. The game pacing may be slowed or accelerated by adjusting the total session time.

### **2.6.3.4**

#### **Advancing levels**

The game provides another word when the player completes the current word. If the time runs out, the game restarts with the same word.



### 2.6.3.5 Technology

The game requires a smartphone equipped with:

- Touch-screen;
- Bluetooth;
- WiFi;
- Camera;
- Light sensor;
- Proximity sensor;
- GPS;
- Vibration motor.

## 2.7 Summary

This chapter presented important aspects of games, as a preparation to the definition, theory and methods used by pervasive games.

In this chapter, we introduced definitions for concept of games, and other important concepts in this area, such as: magic circle, game play, game rules, game state, and game experience. The definitions for the concept of games suggest that there are some common elements in games, such as: rules, goals, challenges, results, (social) interaction, and artificial worlds.

Computer games are the dominant form of gaming nowadays, which have grown up as an important industry in the entertainment sector. As computer games try to create simplified models of the real-world, they represent a test-bed for applying knowledge of many areas in Computer Science. However, maybe due to the playful (and “not serious”) nature of games, research on computer games is in many cases underrated.

The chapter provided a discussion about game design in general, with definitions for this concept and presenting how game design relates to our methodology.

Finally, the chapter provided the first part of our case study – the general game design of *Pervasive Word Search*.