Using an RFID game to phenomenologically test a theoretical systemic model for describing ambient games

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Abstract

Imagine what Brian Eno's genre defining 1978 album Music for Airports (Eno, 1978) would be if it were a game. The game might produce a mood in an environment; the player able to dip in and out of play, which could be facilitated by not having to carry gaming devices, allowing periods of disengagement from the game. The player's everyday actions would generate data to move the game forward, causing game events. However, it should also be possible for the player to change their behaviour in order to participate more actively in the game, varying their involvement with the game from intense engagement to forgetting they are even playing. The proposed game would span both real and virtual worlds, with player actions in the real world affecting events in the virtual world. We have named this imagined game genre 'ambient games' (M. Eyles & Eglin, 2007a). Ambient games may be considered a type of pervasive game ('a radically new game form that extends gaming experiences out into the physical world' (Waern, 2006)) in which the game is embedded in the environment and the player may not need to carry digital equipment around with them and, crucially, can continue to actively play while ignoring the game.

This paper proposes a systemic domain (Eglin, Eyles, & Dansey, 2007) theoretical model for understanding the underlying properties of ambient games, comparing and contrasting them with computer and video games. The theoretical models of both computer and video games and ambient games are used to generate player activity gameflow diagrams, in which the progress a player makes through the domains in the systemic models while playing a game are clearly shown.

A game design research methodology (M. Eyles, Eglin, R., 2008) is used to investigate the ambient game systemic domain model and player activity gameflows. Ambient games, using RFID technology and pedometers, allow players to experience a game in which they are able to vary their involvement while engaged in other everyday activities. In order to discover the lived experience of players of ambient games existential phenomenological methods and in particular template analysis (King, 2008) are used. Studies and observations are described in which ambient games are used within the overarching game design research methodological framework.

Keywords

System, console, video games, games, pervasive, ambient, ambient intelligence, ubiquitous computing, playfulness, phenomenology

Introduction

The Integrated Project on Pervasive Gaming, iPerG, defines pervasive games as: 'a radically new game form that extends gaming experiences out into the physical world…Players equipped with handheld and wearable interfaces move through the world.' (Waern, 2006). Ambient games are intended to be very much like pervasive games and may be considered a type of pervasive game. Where they diverge from the description of pervasive games given above is that although the players are interacting in a digital game form they often do not need to carry digital equipment (handheld and wearable interfaces) with them and are able to forget they are playing the game, while continuing to generate game data. Mechanisms for interacting with the game are embedded in the world as ubiquitous computing devices, similar to those of ambient intelligent environments. Ambient games have uniquely distinguishing features that allow players to choose their level of involvement to the extent that players may even choose to have no involvement, while still playing the game.

Ambient games were inspired by ambient music: 'a style of largely instrumental music, characterized by its predominantly electronic textures and the absence of a (persistent) beat, which is designed to create or enhance a particular atmosphere or mood, esp. of relaxation or contemplation.' (Oxford English Dictionary Online: Second Edition, 1989) They seek to create a mood or atmosphere in an environment. As ambient music may not have a (persistent) beat, so the pace of ambient games may be variable, drawing the player into a game experience that changes according to their chosen involvement.

The 2001 game Pirates! is a game in which players move round a physical location holding handheld computers, connected to a wireless local area network, on which a multiplayer pirate game is displayed; their location affecting movement in the virtual pirate world shown on the PDA and the interactions they can have with other players. (Björk, Falk, Hansson, & Ljungstrand, 2001) Pirates! is an excellent example of a pervasive game in which movement in the real world affects gameplay in a virtual world. This is very similar to the proposed ambient games except that players of Pirates! are required to have a greater commitment to the game (to progress in the game they interact with other players and non-player events) and they also are required to carry game playing equipment (handheld computers).

Low cost solutions to investigate ambient games are suggested, in which ambient intelligent environments are simulated. The distinction between these ambient games and pervasive games is the intention that the player can change their level of involvement and even continue to play without being aware that they are playing. The low cost game prototypes require the players to carry equipment, but note that the game is not played on this equipment. The equipment is solely to generate data, which is then used to drive gameplay in the accompanying virtual game environments.

The ambient game prototypes are investigated within a game design research framework (M. Eyles, Eglin, R., 2008) which has been built on an existing design research methodology used in information systems (Vaishnavi & Kuechler, 2004). An existential phenomenological approach is used to gather data on the user experience of playing the ambient game simulations. A template analysis method (King, 2008) is used to assist in the coding of information, which is then used to support the theoretical model that has been proposed to describe the underlying properties of ambient games.

Using phenomenology in a game design research context

We have previously described using design research to examine games (M. Eyles & Eglin, 2007a, 2007b; M. Eyles, Eglin, R., 2008) building on the application of a design research approach in information systems research (Vaishnavi & Kuechler, 2004) and also on design research as previously applied to games (Zimmerman, 2003) and more generally to modern design practice (Laurel, 2003). An iterative loop lies at the heart of game design research. Develop some ideas (possibly hypotheses), develop a game prototype to investigate (or test) those ideas, evaluate the prototype against the ideas, modify the original ideas, develop a prototype, evaluate the prototype, and so on, round the loop until the ideas are shown to be verifiably accurate.

First attempts at applying game design research showed that the iterative nature of this approach was effective. Developing prototypes iteratively allowed the exploration of the ideas underlying ambient games (Eglin, Eyles, & Dansey, 2008; M. Eyles & Eglin, 2007a, 2007b). However, the methods being used to explore the player experience of ambient games were not effective. There were two problems, firstly gathering quantitative data and secondly running the experimental games over long periods of up to eight weeks.

The quantitative approach required players filling out questionnaires on their gaming experiences. The player response to the questionnaires was very poor and although some interesting trends were hinted at, the data was not significant due to the small number of questionnaires completed. More information was gathered by talking to players about their experiences. When it became clear that no useable quantitative data was being generated by the questionnaires a decision was taken to switch to a qualitative approach. A number were considered, but quickly it became clear the required information could be best gathered by adopting a phenomenological approach. The information required was the players' experience of playing the ambient games. This could then be used to confirm or refute the model under development to describe playing ambient games; exploring specific phenomena (qualities) of specific ambient games; searching for, and identifying,

underlying components and hence the essential nature of ambient games.

Phenomenology has been simply defined as describing 'the meaning for several individuals of their lived experiences of a concept or phenomenon' (Cresswell, 1998). Phenomenology has roots in the philosophy of Edmund Husserl whose ideas were further developed by Martin Heidegger with the addition of the existentialism of Søren Kierkegaard (Langdridge, 2007). Interpretive phenomenological approaches, such as interpretive phenomenological analysis (developed by Jonathan Smith, University of London in the 1990s), hermeneutic phenomenology (very clearly described in the book Researching Lived Experience (Manen, 1990)) and a more recent variation, template analysis (developed by Nigel King at the University of Huddersfield (King, 2008)) grew out of this.

The researcher is empirically linked to the data derived from investigating phenomena; developing an understanding by seeking to see to the heart of phenomena. This understanding is derived through the researcher's intrinsic link with the material. The researcher does not stand outside looking in, but is necessarily immersed in the phenomena; they are part of a holistic whole in which their intentionality is focussed on particular phenomena. When exploring games using a design research approach the researcher is necessarily immersed in the process of investigation through their work on creating the prototypes required to test ideas and so on. They may need to develop heuristic insights (as described by Clark Moustakas (Moustakas, 1990)) revealing truths about the phenomenon through reflections on their own (and co-researchers') interpretations and responses to the phenomenon (Patton, 2002). The researcher focuses not on subjects and objects, but on what is experienced (noema) and the way it is experienced (noesis) (Langdridge, 2007).

A theoretical systemic domain model had previously been developed for describing games (Eglin et al., 2008) and this theoretical model is included here as it forms the basis for a theoretical model for ambient games. The ambient game theoretical model was developed through reflections on the proposed underlying properties of ambient games and the observed and reported experiences of players of ambient game prototypes. In line with game design research methodology once the model had been developed games were built to test it and a phenomenological approach was adopted to gather data from players of this ambient game.

The specific phenomenological approach taken was template analysis, since this required the researcher to have a template of themes that they could use for coding data. Template analysis also allows a wide variety of data sources, not just interviews (Langdridge, 2007; Teal, 2008). The ambient game theoretical model offered a clear selection of themes that could be explored through semi-structured interviews and observations.

Ethical considerations

When ethical approval was sought for this research, it became clear that ambient games have particular problems that are not shared by other types of game.

A fundamental property of ambient games is that people can start playing them through their everyday actions, coming into contact with them without prior knowledge. When people become aware of the games they can then choose their level of involvement, ignoring the games or becoming strongly engrossed in them.

The following question was raised by the faculty ethics committee who reviewed this particular research:

> "Does the game have to be set up in a public area where non-participants might be filmed or photographed without their consent? "

The initial plan had been to run the RFID game in a public area, the entrance lobby of a building, in order to see if it drew in people passing through. However, it became apparent that this would cause ethical difficulties as the consent of everyone involved was required. A compromise was arrived at, running the game in a less public area, which was not a thoroughfare. The area chosen to run the game was a basement area where computer labs could be accessed. This area only had two entrances on which signs were placed announcing that an ambient game was running and people might be filmed as they moved through the area.

The fundamental problem is running an ambient game in a 'real world' situation (say a shopping mall or town square) while observing what happens requires covert observation. The British Sociological Association - Visual Sociology Group has this view: "there are serious ethical and legal issues in the use of covert research but the use of covert methods may be justified in certain circumstances. For

example, difficulties arise when research participants change their behaviour because they know they are being studied." (Visual Sociology Study Group of the British Sociology Association, 2006) Getting informed consent and discussing participation is suggested in almost all cases, unless it can be shown that "the public interest dictates otherwise and particularly where power is being abused, obligations of trust and protection may weigh less heavily" (ibid). Ambient games do not seem to offer a compelling reason for discarding informed consent in favour of covert observation.

Possibly ambient games might be viewed in the context of a 'field stimulation' research method in which the researcher makes an intervention (i.e. the game) and observes what happens. "...in a field stimulation participants do not know they are being studied." (Bryman, 2008)

However, the intention of the games designed for this research is that:

1. There will be no harm to participants.
2. There is no invasion of privacy (notices will clearly state that players will be observed).
3. There is no deception - interest in players of the game, not asking them to do one thing in order to covertly discover something entirely different.

There is a possibility that the ethical constraints may make some areas of research in ambient games very difficult.

Systemic domain model

Computer and video games, including pervasive games, are complex systems that comprise not only the games but also the players. The ways that players interact with gameplay mechanisms, and hence games, fall into three broad categories, or domains: engaging, generating data and perceiving feedback (Eglin et al., 2007).

Engaging

Engaging with a game is typified by:

- an acceptance of the game system (rules, goals and so on)
- entanglement with gameplay and ideas of gameplay
- focus on the game (sometimes entering a flow state)

Generating data

Data is generated when players make decisions that lead to inputs, resulting in changes within game worlds. Notice that this data generation has been broken down into a number of small steps, separated by time intervals:

1. decision (note that this step may be missing in ambient games)
2. input from player (via joypad/keyboard/camera etc.)
3. input received by game computer (PC, console, mobile phone etc.)
4. consequences of input calculated
5. change made to the game world (environment, characters, objects)

Perceiving feedback

Often after generating data players observe, or otherwise perceive (sound, touch and maybe even smell or taste in the future) the process and consequences of their actions:

- they notice themselves making a decision
- they are aware of their movements (or other physiological phenomena) that generate data (i.e. move a finger to press a button)
- they notice the immediate mechanical/electronic consequences of their movements (i.e. button depresses)
- they watch the consequences of the input of their data (i.e. changes to the game world)

(Eglin et al., 2007)

Domain models of game play

Figure 1 shows the three domains and their interaction while playing a game. The grey shaded area represents the player's experience of playing the game. They are engaging, generating data and perceiving feedback. This diagram covers the time that a player is actually playing the game. This does not include the time before the player started playing or the time after the player finished playing. Nor does it include breaks in play (i.e. to go and make a cup of tea, go to work, sleep). Similarly, this does not represent a player's actions in a split second; rather it represents the sum of actions over a game playing session (perhaps an hour or so).

If a split second were to be considered it may be that the player was, for example, only

perceiving data at that split second. A fraction of a second later they might be engaging with the game and a fraction of a second after that they might be generating data. This has been described as viewing the game at different granularities, with a courser granularity covering the whole play time while a finer granularity lasts only for a fraction of a second (ibid).

Figure 2 shows the possible situation when not playing the game (before and after play). At this time the player is thinking about the game and may be observing it, but not actually playing it, that is they are not generating data. Once again this diagram is showing the situation at a coarse granularity. If this was viewed at a finer granularity the player might be moving freely between the different areas as they engage in different activities, second to second and minute to minute. They might also disengage entirely from the game (forget about it and not be observing it) and move outside the domains shown in the figure.

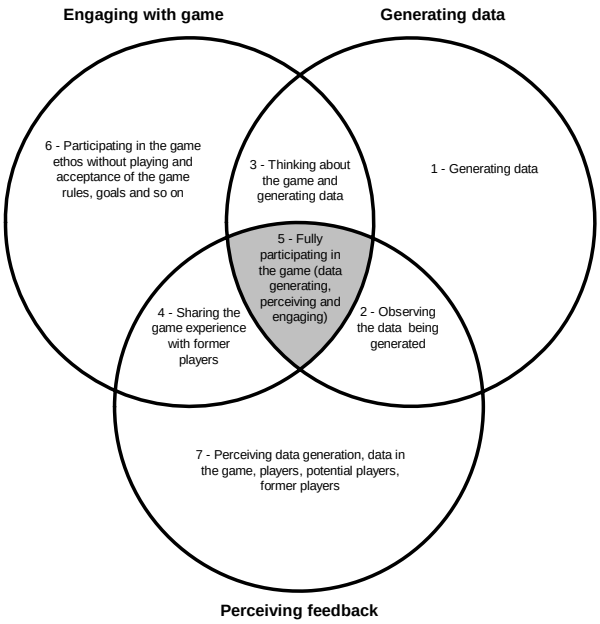

Figure 1: Playing a computer or video game

Figures 1 and 2 provide a useful way of thinking about how players interact with games. By considering the activities represented by each of the areas in this systemic domain model it is possible to postulate a type of game that is represented by a different combination of domain areas.

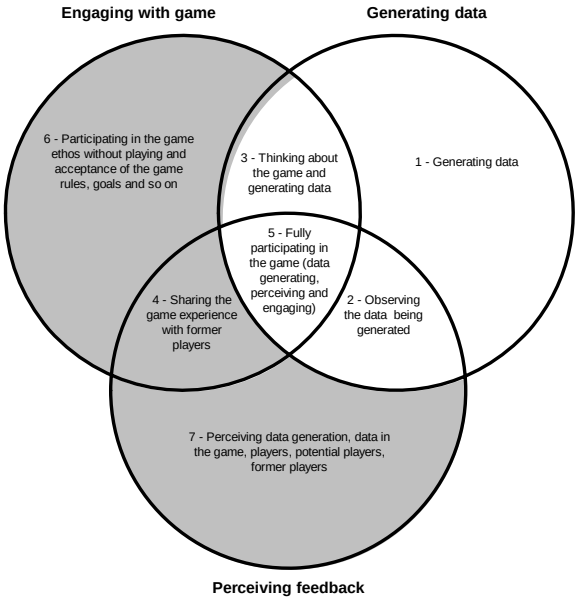

Figure 2: Before and after playing a computer or video game

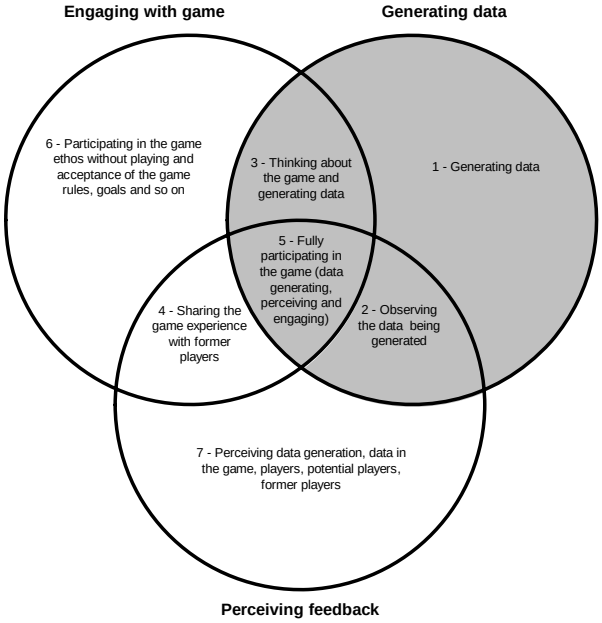

Figure 3: Playing an ambient game

Figure 3 shows the player experience of playing a game in which they may choose to be fully involved (as they were in the game shown in figure 1) or not involved, but still playing (represented by area 1 'Generating Data', in figure 3). In this type of game, the player may pass between the four shaded areas (numbered 1, 2, 3 and 5) while playing:

- They may be only generating data, while not thinking about the game at all (area 1).
- They may be observing the data being generated while not engaging with the game (i.e. not thinking about the game, area 2).
- They may be thinking about the game while they are generating data, but not perceiving the game consequences of their actions (area 3).
- They may also be fully engaged in the game; generating, observing and engaging with the game (area 5).

Note that there is always the possibility of generating data (even when not thinking about the game); this is a characteristic of the proposed ambient style of game. Crucially it is possible to be generating data without having made a decision. 'Decision' was the first of the steps listed in the description of 'generating data'. This is a fundamental property of ambient games. When players are in area 2, only observing, or in area 1, just generating data they are clearly not engaging with the game, though they may be said to be engaging with the process of generating data.

For example, say a game, let's call it 'Fidget Racer', measures movement of a player with a remote sensor (camera, infrared or similar) and the movement of the player powers a racing car travelling round a circuit in competition with cars controlled by other players. The player may concentrate on their movement and be aware of the movement they are taking (area 2) or they may move around, and fidget, without thinking about it (area 1). In this example the player is continually generating data for the game; that is they are constantly powering their car round the track.

They may look away from a screen where the car and track are shown, and think about the game (area 3). They may observe the game on the screen, be conscious of their movements and also think about the game and how they can improve their ranking in the race (area 5).

The player can have a range of involvement with Fidget Racer. At one extreme they can ignore the game; at the other extreme they can jump up and down and run on the spot, increasing their movements while watching their car move round the track.

This gives us a spectrum of engagement, with 'ignore the game' at one end and 'extreme engagement with the game' at the other. This engagement spectrum is not unique to ambient games, but the ability of the player to move to the 'Ignore' end of the spectrum is one of their defining characteristics, this corresponds to 'generating data without having made a decision'. Note that players of ambient games may also move towards the 'Extreme engagement' end of the spectrum.

A further consequence of this possibility of the player altering their level of engagement with the game at will is that game involvement is wholly controlled by the player. They are not forced to interact with the game once they start playing it.

Consider traditional console and computer games. Once the player starts a game they are committed to a high level of involvement. For example, when playing a first person shooter (Doom (id Software Inc., 1993), Quake (Id Software Inc., 1996) or Unreal Tournament (Epic MegaGames Inc., 1998) etc) the game constantly pressures the player to interact with the game as enemies attack. They can find a safe spot to 'rest', but in order to progress with the game they must fight more enemies. If a player is resting in a safe spot they may walk away from the game: at which point they have stopped playing (they are no longer progressing in the game). There are also games where taking time between interactions is built into the game play. Point and click adventures like Myst (Cyan Worlds Inc., 1994) or turn based strategy games like Civilization (Meier, 1991) offer the player clear opportunities for rest breaks while playing. However, the player still needs to return to the game to continue playing, and the game demands a certain minimum level of involvement. Myst requires the player to solve puzzles actively; Civilization requires empire-building decisions. A crucial difference with the proposed ambient games is that in the ambient games the player controls their involvement; the game does not require the player to make more moves in order to keep playing. In the example, the player is playing whether they are thinking about the game or not. Neither Myst nor Civilization can be played without thought.

So traditional computer and console games typically feature a type of technology similar to Internet 'push' technologies, where information is sent to the user without a request (Oxford English Dictionary Online: Second Edition, 1989); an event in the game demands a response from the player without the player having 'requested' it. For example, monsters attacking in first person shooters demand the player's attention. Although there may be times during a game where the game does not immediately demand attention, there

are times when the player has to react in order to continue playing. The pace of the game is being set by the game; the level of player involvement is being dictated by the game.

Ambient games not only do not feature 'push' type events but also their pace is determined entirely by the player. This is rather like browsing simple web pages where the viewer determines both the pace of browsing and also does not have pages, or other data, forced onto them; this is pull technology (The Computer Language Company Inc., 2007).

Juul describes the relation of game 'event time' to player's 'play time', linking 'play time' and 'event time' lines with arrows to show the mapping of play with events in the game. Figure 4 reproduces one of Juul's diagrams for a game with cut-scenes (Juul, 2004) and a diagram for an ambient game. In the game with cut scenes play stops while the cut-scenes occur, there is no mapping of player involvement to events in the game; player inputs are suspended. In the ambient game there are periods when the player is fully involved with the game and when player inputs map directly onto events in the game. However, there are also times when the player is less aware, to the point of completely unaware, of their involvement in the game. During these periods of lesser involvement (shown by pecked lines) player actions are still directly linked to events in the game. These are periods when player actions in the real world are having an effect on events in the game world.

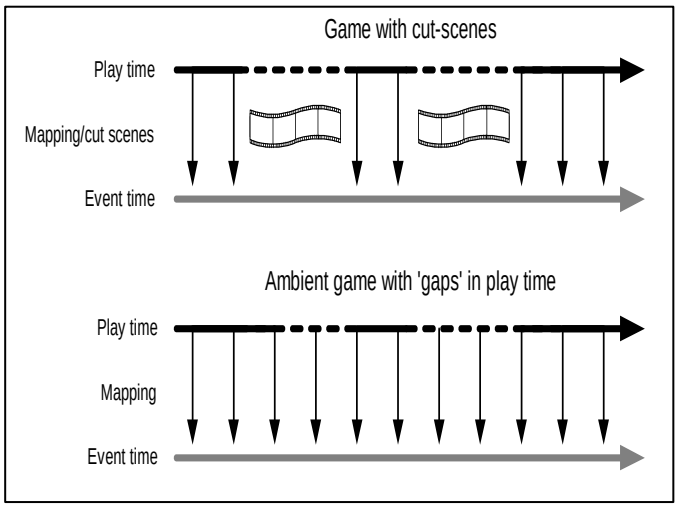

Figure 4: Game play and game event mappings in ambient games

Player activity gameflow theoretical model

The player activity gameflow diagrams show the sequence of player activities while playing a game. The activities and routes through the games are given two priorities: 'Primary' and 'Optional'. The primary route is the simplest way through necessary activities, shown by solid boxes and arrows. The optional routes and activities may be chosen by the players, but are not essential to playing the games. The numbering given in the boxes refers to the areas in figures 1, 2 and 3.

Playing a console game

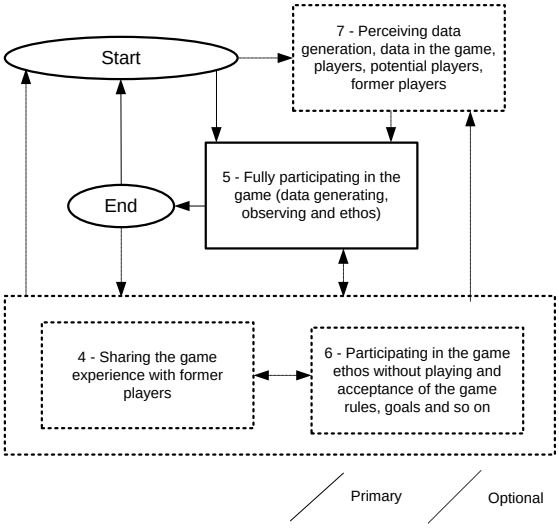

Figure 5: Player activity gameflow for a console game

Before playing a console game the player may first watch players playing the game or may start playing straight away. They then play the game; fully participating by engaging with the rules system, watching what is happening and generating data (by interacting with the game). After playing the game the player may return to watching the game and players or may share their game experiences with other players. They may also return to playing at any time.

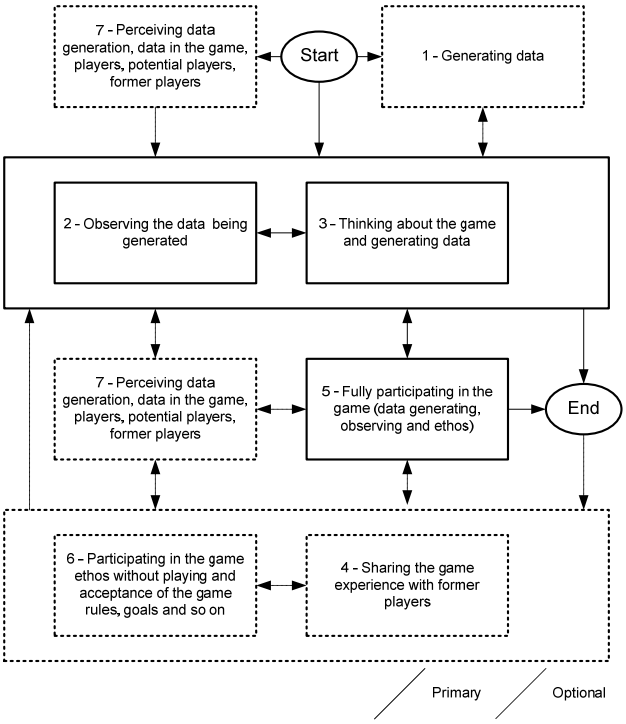

Figure 6: Player activity gameflow for an ambient game

In the player activity gameflow for an ambient game the player may start generating data before they have any knowledge of the game, once they are aware of the game they may continue to generate data and observe the data being generated or think about the game while generating data. Following this, while playing the game they will engage with the game (accepting the rules, focussing on play and so on) and at this point they are fully participating with the game (area 5).

Both the player activity gameflow figures have start and end points. In the case of the console game the start occurs when the player decides to start playing. In the ambient game the start may occur before the player is aware of the game. The end points occur when the player is no longer actively playing the games. Note that the player can move on to other game related activities after they stop playing. They might share their playing experiences with other former players, for example.

Although no link is shown in the diagrams a player might return to the start after reaching the end.

The player activity gameflow figures equally refer to a single playing session or to playing an entire game. The sections between the 'start's and 'end's are true for small parts of a playing sessions, as well as for playing whole games.

The application of the player activity gameflow for ambient games to the RFID ambient game simulation is shown below.

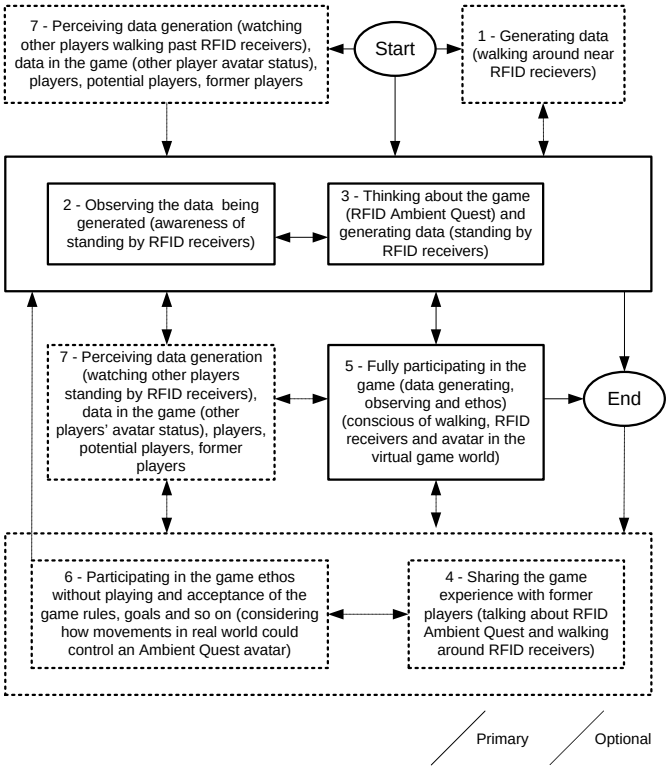

Figure 7: Player activity gameflow for RFID ambient game

Ambient Quest: Pedometer game

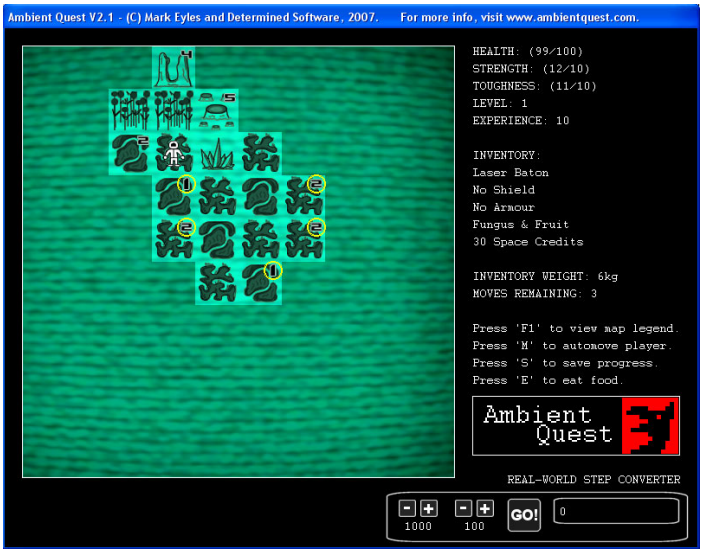

Figure 8: Ambient Quest: Pedometer Game screen

The first game created to explore ambient gaming was the Ambient Quest: Pedometer

game. In this game the player wears a pedometer to record the number of steps they are taking. At the end of each day (typically, this can be more or less frequent) the player enters the number of steps taken into the Ambient Quest game shown above. The number of steps is converted into game moves allowing the player to move their avatar around the game screen both exploring and also fighting enemies as they are encountered. Game items are gained through successful combat and others are found in locations in the play area. The player's character gains experience during the game, levelling up as they progress.

This game allows actions in the real world (walking) to be converted to actions in a virtual world. The player can choose their involvement in the game, either forgetting about the pedometer or altering their behaviour (walking further than normal) to progress more rapidly in the game.

Ambient Quest: Pirate Moods game

The second game created for testing the theoretical model was Ambient Quest: Pirate Moods. The game is played around eight notice boards, each of which has an RFID receiver. The player carries an RFID tag (on a lanyard) which is detected when they move in front of a notice board.

The progress of the game is displayed on a monitor set into one of the panels. An LED on each panel lights when a tag is detected at that location, which gives immediate feedback to the participant that their tag is being detected.

The game can have up to six players and each player has a display panel on screen showing the status of their pirate and pirate ship (in the virtual pirate world). They must keep the attributes that control the ships, pirates and attacking krakens in balance. The attribute balance determines whether the pirate ships are sinking or afloat, the mood of the pirates and the success in battling krakens. Standing in front of a panel generates one of the attributes (bread, rum, canvas, cannon balls etc) required by their pirate. However, gathering too much of one attribute can cause problems for the pirate and ship. When the supplies attributes are balanced, their pirate is happy and they may fight attacking kraken.

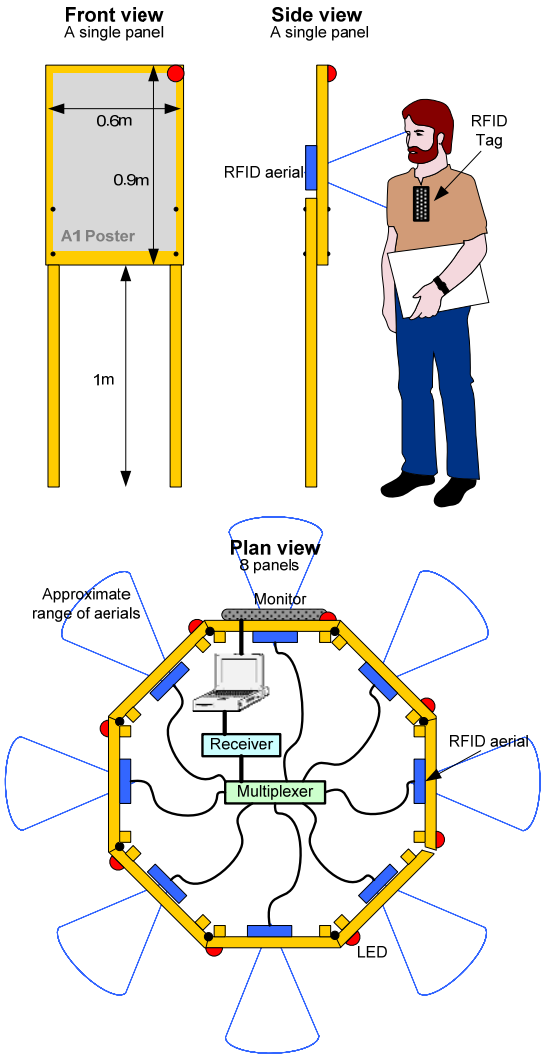

Figure 9: Pirate Moods display boards

Figure 10: Pirate Mood display for one player

This is a very simple game of juggling attributes by standing in front of panels, while reading posters on the panels. Immediate feedback is given by LEDs on the panels and overall progress is given on the monitor.

Players may choose their level of involvement. They may ignore the game and read the posters or they may ignore the posters and concentrate their efforts of playing the game. There is a very clear spectrum of involvement. Data is generated whether they are concentrating on the game or not. They can observe data being generated as the LEDs flash and the attribute bars and graphics change on the display for their pirate. They can watch other players engaging with the game both when they are playing and when not playing. They can generate data before they are aware of the gameplay details. They can engage in the game and the pirate ethos both while playing and when not playing.

Analysis

Template for analysis

A list of the components that form the theoretical models and gameflow diagrams formed a good first list of themes:

<table>
<tr><th colspan="3">THEMES</th></tr>
<tr><th>Outer</th><th>Inner</th><th>Centre</th></tr>
<tr><td>Generating data (1)</td><td></td><td></td></tr>
<tr><td></td><td>Thinking about game and generating data (3)</td><td rowspan="6">Fully participating in the game (5)</td></tr>
<tr><td>Engaging with the game (6)</td><td></td></tr>
<tr><td></td><td>Sharing the game experience with former players (4)</td></tr>
<tr><td>Perceiving feedback (7)</td><td></td></tr>
<tr><td></td><td>Observing data being generated (2)</td></tr>
<tr><td>Generating data (1)</td><td></td><td></td></tr>
</table>

Figure 11: Themes for analysis

These themes formed the basis of initial analysis of data from the ambient games.

Using NVivo for coding

Within the qualitative analysis program NVivo nodes were created for each of the components of the theoretical models, which were taken as themes for the analysis. Nodes in NVivo are used to represent topics, themes or categories. These nodes were then used as a framework for organising information gathered from interviews and observation:

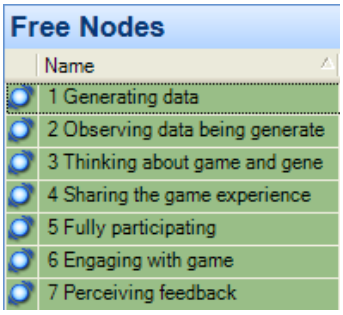

Figure 12: Initial nodes list in NVivo

Although the data may consist of audio recordings of interviews, videos and photos of people playing the game and notes made by the researcher, in this research the data has so far mainly consisted of researcher notes and interviews.

Photos, videos and audio can be loaded into NVivo for coding and sections of these can be tagged and connected to nodes. The research interviews were not transcribed, but instead they were coded using the audio of the interviews. Relevant excerpts were transcribed and attached to the timeline of the audio along with notes. These transcriptions (along with sections of audio) were then attached to nodes.

In addition to the nodes connecting to data (e.g. audio and transcriptions), the program also allows normal qualitative procedures such as the creation of memos which can then be attached to nodes, data and so on. Relationships may be made between items. Entities such as people, places and games can be represented by ‘cases’. Data can also be interrogated with ‘queries’ and displayed in charts. (QSR International, 2009)

NVivo was chosen in preference to ATLAS.ti (another leading package for qualitative research) since it seemed to have a better interface for working with audio files and looked much more up to date (and user friendly), though both pieces of software would support the types of analysis required for this research (ATLAS.ti Scientific

Software Development GmbH, 2009; QSR International, 2009).

Once the notes, interviews and so on were loaded into NVivo they were annotated throughout and linked to the NVivo nodes, including 'template nodes'. During this process memos were also created to store ideas and were connected to existing themes and the data. In addition to the themes represented by the template nodes other ideas and themes emerged as the interviews were coded. New nodes were created to contain these. The list of nodes created so far is shown in figure 13.

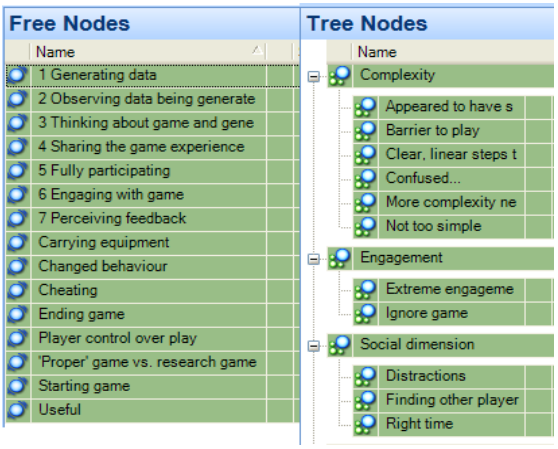

Figure 13: Ambient game nodes

Findings

The interviews on which these findings are based were conducted with players of the Ambient Quest: Pedometer game. These findings are also based on observations and discussions of the researcher, which were recorded in research notes.

The initial indication is that the theoretical gameflow model that was derived from the systemic domain model that had previously been created in this research (Eglin et al., 2008) was supported. 'Player 3', in these results, played the Ambient Quest: Pedometer game for eight weeks in 2008 and provided particularly rich data.

1. Generating data

Player 3 often generated data without awareness of the game, forgetting that he was wearing the pedometer:
'Quite often when you're out it's not like you're thinking about the pedometer 'cause you can't feel it and it's not heavy or anything'

2. Observing data being generated

Other times player 3 was conscious of the data generation, however often this awareness did not include an awareness of the game, just of the data being generated:

'I'd wonder how many steps it was from here to the other place'

3. Thinking about the game and generating data

The game was always present in the background, ready to grab player 3's attention:

'It was largely about the pedometer, but it wouldn't have meant anything without the game'

'On the whole I think the physical object [pedometer] has some minor advantages, just 'cause it's something to remind you that you're playing some, playing the game'

This seems to be showing the importance of the pedometer in this particular game. The pedometer seems to be representing more than just a device for counting steps, but also to be embodying the game in some way.

4. Sharing the game experience

Player 3 did not report talking to other participants about playing the game and did not give any evidence of sharing the experience. However, other players of this game have shared the experience, in particular, at the Women in Games 2007 conference, at the University of Newport, players did discuss the game amongst themselves and there was some competition between players to see who walked the furthest.

Ambient Quest: Pedometer is a single player game so it may be that this explains the lack of engagement with other players shown by some players. An ambient game that requires players to cooperate could be expected to have much more sharing of the experience.

5. Fully participating

Player 3 was not only aware of counting steps and that they were connected to the game in some way, but also fully participated by saving them up, which implies that he thought about the game and how the steps were connected to it, then used the 'saved' steps for his moves in the virtual game world.

'Saved them up [steps] until I had lots, like 30,000 or something and then just put them all in' - to create moves in the game.'

6. Engaging with the game

A number of comments by player 3 show the extent to which he engaged with the game. For example:

'If I happened to forget it, it was 'oh no, I forgot it'.'

Seems to show how he had an emotional link to the game and was (slightly) upset when he forgot the pedometer. He sometimes admitted that he would:

'Just cheat and shake the pedometer.'

The implication from the idea of 'cheating' is that he was aware that he was deviating from the rules of the game. This shows an engagement with the game; if he had not engaged with, and accepted, the game rules he would not have considered shaking the pedometer as 'cheating', but just another way to increase the score.

7. Perceiving feedback

There is ample evidence that player 3 was aware of generating data and of the use of that data in the game, though this was mainly his own play as he did not engage with other players.

'I'd wonder how many steps it was from here to the other place'

This quote shows player 3 thinking about the generation of data, the implication being that he was checking the steps (data) frequently enough to be able to speculate on distances as measured in steps.

Emergent themes

There were a number of themes that emerged outside of the template codes. These give a deeper understanding of the experience of playing an ambient game and indicate directions for future research.

Carrying equipment

As noted in '*3. Thinking about the game and generating data*' above the use of some equipment that signifies involvement in the game seems to be significant. Future investigations will need to be carried out to discern how important this is. Perhaps this is connected with all the paraphernalia that exists around games and ties into the acceptance of rule systems and so on.

This may also connect with another theme of player control over play. The Ambient Quest: Pedometer game did offer players the opportunity to stop playing:

'if you decide 'I do not want to play today' you can take it [the pedometer] off' (Player 3).

There is still not enough data on this to draw firm conclusions about player control, but it seems likely that the 'always on' nature of ambient games may make some people feel uncomfortable.

Cheating

Whenever the Ambient Quest: Pedometer game has been run there have always been discussions between players about cheating as is shown from this quote from researcher notes on Women in Games 2007:

'people were also now telling me how they were managing to cheat (shaking their pedometers)'

One of the players of the Women in Game 2007 ambient game reported:

'[Player name] suggested that the cheating was fine while the reset button was intact since the pedometer had cheated by resetting itself. After removing the reset button she didn't want to cheat any more.'

This quote from researcher notes is about the use of the pedometers for this game. They had an external reset button that could be accidentally pressed.

Figure 14: Pedometer showing external reset button

There were a number of discussions about how unfair this was. Finally, players started modding the pedometers by removing the reset buttons.

The freedom inherent in ambient games seems that it may offer many ways to circumvent game rules.

Complexity

Complexity seems to be emerging as a major theme of ambient games. They need to be complex enough to maintain interest, but no more complex than this. Too much perceived complexity seems to be a barrier to player involvement. A dice and paper version of Ambient Quest was handed out to students during induction week in October 2008. Unfortunately, this game did not engage the students:

'it looked, like, quite complicated' (player 1)

'don't know where to look [on the dice game sheet], but once you got over that it didn't look all that confusing really' (player 3)

However, Ambient Quest: Pedometer seemed to be about the correct complexity:

'it was enough to keep me interested for the project' (player 3)

Though this player went on to say:

'if it were to be like a proper game you play for a long time it would have to be more complex, I think'.

The player was differentiating between a 'research' game and a 'proper' commercial game. This seems to be indicating that there is a whole area to explore concerning attitudes towards games for research. How generalizable are the results from games used in research? Carrying out research similar to that carried out with Ambient Quest: Pedometer game with the Nintendo DS game 'Walk with me!' (Nintendo, 2009), in which players use a pedometer to track the distance they walk over a day and then use this to drive activities on their Nintendo DS, might offer some insights.

Figure 15: Nintendo DS game 'Walk with me!'

Conclusion

The systemic domain model gives a useful way of breaking down games into component activities of the players. Granularity (time) used when describing games has also been shown to be of importance.

The ambient game model described shows distinct and fundamental differences between PC, console and pervasive games and ambient games. Data from Ambient Quest ambient game simulations support this model as is shown in the findings.

A theoretical model has been given for ambient games. The validity of using a phenomenological approach, exploring and analysing the lived experiences of players, has also been trialled. The design research methodology and phenomenological method used in this research have offered a flexible and robust approach to exploring games.

Themes of complexity, cheating and the carrying of equipment seem to have important implications for the design of future ambient games. Balancing the difficulty level of ambient games seems to be of paramount importance, in particular allowing players greater flexibility in their involvement and allowing them the possibility of a very shallow learning curve. Ways of controlling cheating either by incorporating behaviours that might be perceived as cheating into the games or by making the games more robust and 'cheat-proof' need to be considered. The whole issue of gaming equipment is core to ambient games; they were originally conceived as being independent of any player carried equipment. However, this ideal might not offer a satisfying game experience and might disempower players who might feel that they have no control over the game.

There is still much work to be done to validate further the theoretical model for ambient games, gathering data from a wider range of players and different ambient games. Do all players have a similar experience as described in the theoretical model? Are there different types of player, perhaps along the lines of virtual world player types (Bartle, 2004)? Does the model describe all ambient games? More widely, there seem to be issues around the generalizability of results from games created specifically for research and played within the context of research.

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