# Entering an age of playfulness where persistent, pervasive ambient games create moods and modify behaviour

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## ABSTRACT
A novel way of playing games called ambient gaming is defined and described. Growing out of ideas in ambient music, ambient gaming is defined as 'ignorable as it is interesting'. (Eno, 1978) Ambient gaming is set in the context of existing gaming systems, including computer games, Live Action Role Playing, augmented reality and pervasive gaming. Further, ambient games are set in a technological context, showing that the technology enabling their development is now becoming available. The specification and implementation of an ambient game prototype, Ambient Quest, is described. Finally future directions for research and application of ambient games are given.

## Categories and Subject Descriptors
K.8.0 [**Personal computing**]: Games.

H.5.1 [**Information interfaces and presentation**]: Multimedia Information Systems - *artificial, augmented, and virtual realities.*

H.5.2 [**Information interfaces and presentation**]: User Interfaces (D.2.2, H.1.2, I.3.6) - *input devices and strategies (e.g., mouse, touchscreen), interaction styles (e.g., commands, menus, forms, direct manipulation).*

C.2.4 [**Computer-communication networks**]: Distributed systems – *distributed applications.*

## General Terms
Design, Experimentation, Human Factors

## Keywords
games, role playing game, pervasive, augmented reality, alternate reality, live action role playing, ambient, ambient intelligence, ubiquitous computing, pedometer, playfulness

## 1. INTRODUCTION
This paper seeks to address four questions around the concept of 'ambient games'. What might the game equivalent of ambient music play like? What technologies would this require? How could an ambient game be produced (with limited resources)? What is the potential for exploiting ambient games? In answering these questions the basis for ambient gaming is explored and practical suggestions are offered for building and running simple ambient games.

## 2. AMBIENT MUSIC
Brian Eno coined the term 'ambient music' on his album Ambient 1: Music for Airports released in 1978. In the sleeve notes of Music for Airports Brian Eno gives a definition of ambient music, "Ambient Music must be able to accommodate many levels of listening attention without enforcing one in particular; it must be as ignorable as it is interesting." (Eno, 1978) In a talk he gave for the Long Now Foundation's series of Seminars About Long Term Thinking in 2003 he talked about Music for Airports "I wanted to make a kind of music that would actually reduce your focus on this particular moment in time that you happened to be in and make you settle into time a little bit better." (Eno, 2003)

Since Music for Airports there have been many pieces of music produced that purport to be 'ambient music'. The CD 'Ambient: A Brief History of Ambient Volume 1' released by Virgin Records in 1993 there are artists as diverse as Hawkwind, Gong, Nusrat Fateh Ali Khan and Killing Joke as well as more obviously ambient artists like Harold Budd, Tangerine Dream and Holger Czukay. (Hopkins, 1993)

The description of ambient music and the ambient pieces produced by Brian Eno serve as a guide to the creation of an 'ambient games' definition and acts as a useful reference point and context for the creation of ambient games.

## 3. DEFINING COMPUTER GAMES
A video or computer game is an interactive entertainment played against, or with the aid of, computer generated characters or tokens in a computer generated environment. A single player game has a series of interesting obstacles to overcome in order to gain rewards. A multiplayer game has a series of interesting obstacles to overcome at the expense and/or with the help of other players to gain rewards. Games require a commitment of time and effort from the player. This commitment varies widely between games. A large and involving strategy computer game like Civilization 2 (or any other game in the Civilization franchise) may require many hours of play and thought from the player. There is also a substantial learning curve at the start of the game before the player is able to play proficiently. When starting a game like this the player is often committing themselves to 50+ hours of play, stretching over weeks or months. A simple game like Tetris has a very shallow learning curve (the player can start playing almost immediately) and requires very little commitment from the player, though a player may choose to make a larger commitment

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of time and effort to the game if they wish. The word completion game hangman requires very little commitment and has virtually no learning curve for the average person.

Current computer game technology may be found in commercial devices such as consoles (PlayStation 3, Xbox 360, Nintendo Wii), computers, handheld devices (mobile phones, Nintendo DS, Sony PSP), set-top boxes (Gamestar on Sky Active, delivered by Sky through Sky Box satellite receivers) and arcade machines

All of the devices except the handheld devices are not mobile, when playing on them the user is in a single location. However the PlayStation Eye Toy and Nintendo Wii have interfaces that require users to stand and move around while playing, although within a very small area. There are other gesture interfaces that predate this. The Mandala 'video-based interactive gesture control of computer processes' system was patented by GestureTek corporation in 1996 (GestureTek).

The handheld devices allow the player to change location while playing; these location changes are not currently connected to gameplay. However, devices with global positioning systems can be used for playing locative games. The obsolete Gizmondo was an interesting example of a device that combined location and connectivity with gameplay. (BBC News, 2005)

Another characteristic of games is where they are played. For example, console games are played in a single location, the console does not move around during play, though the player may move a small amount while playing. A game on a mobile phone does not normally require the player to move around while they are playing, but does allow the player to move around if they wish to. Though there are a small number of games that do require movement. The game may be played in any location (which has conditions that will not damage the phone). Similarly the class of games labelled 'ambient games' allow the player to move freely around everyday locations while playing. The player does not have to travel to some kind of ambient arcade but can play ambient games in the environment they normally inhabit. There are also games that require the player to move around while playing, especially outside of computer games, frequently in locations specially prepared for the games (such as football fields, tennis courts and so on). There are many sports in which the players are required to move around. The rules for cross country running require the participants to move a large distance.

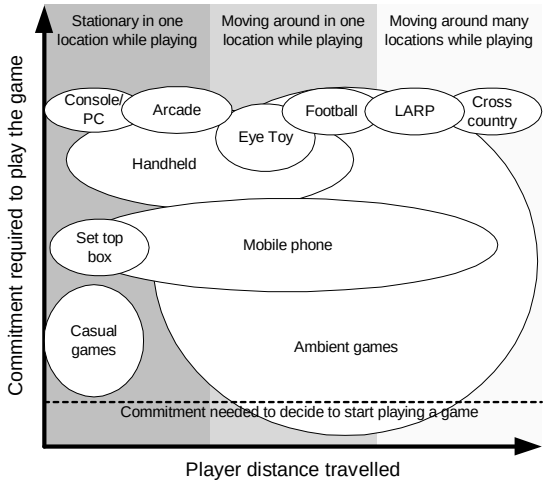


**Figure 1. Commitment and movement when playing games**

By plotting player commitment against the distance the player may travel while playing it becomes clear that there is an undefined class of games that do not require large commitments and in which the player may move around (perhaps be required to move around) while playing. This class of games has been labelled 'ambient games'. See the 'Commitment and movement when playing games' figure. The areas marked out for games in this figure are not definitive, there are plenty of exceptions, but they are intended to broadly indicate general areas of commitment and movement.

This figure has a threshold marked showing the commitment required to start playing any game. Below this threshold the player has not yet committed to starting playing. At, and above, this threshold the player is deciding to start, and is actually starting, a game. Below this threshold they have not got the will, or intention, to start playing.

As implied by the 'Commitment and movement when playing games' figure the key component of an ambient game is that the player may choose their level of interaction with the game. They may choose to actively influence events in the game, or may let those events evolve with input automatically gathered from the player's real world activities. As with Music for Airports an ambient game should accommodate many levels of attention, many levels of involvement or intervention.

## 4. SPECIFYING AN AMBIENT GAME

An example of a game that requires minimal player intervention is Progress Quest (http://www.progressquest.com/) (Fredricksen, 2004). All a player needs to do to play Progress Quest is set the game running. The game displays the player's character's role playing statistics and lists the completed quests and so on. The player need not intervene again as Progress Quest continues to play, all gameplay decisions are made automatically.

In order to play Progress Quest the player has to start the game running, consequently it may be argued that there is some (minimal) participation from the player. However it is not possible to play the game without starting it running. A player might ask someone else to start the game running for them, but they would still have made a decision to play the game, they would be actively involved. There is no possibility of playing the game unknowingly. Even if the player were to set up a program that started Progress Quest at random times while the computer was turned on they would still have made a decision to start the game.

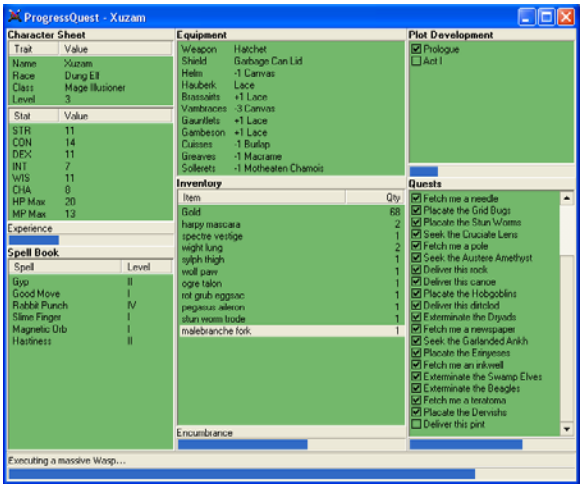


**Figure 2. Progress Quest**

Progress Quest shares characteristics with films. The game requires the same sort of interaction that is necessary for watching a conventional film on DVD. The player starts the DVD playing and then watches the story unfold on a screen. The difference between a film and Progress Quest is that in a film all the decisions have already been made. The viewer will see the same sequence of scenes whenever they watch the film. Progress Quest generates the story in real time. Players assume a new identity every time they start a new game of Progress Quest and become participants in a new story.

Imagine a game similar to Progress Quest in which after the game starts, the player's actions in the real world affect progress in the game world. The game world consists of a virtual environment containing quests to complete (achieved by defeating monsters at various locations). In this game the player chooses the degree to which they wish to manage events in the game. At one extreme the game runs itself, gathering data from the player's actions in the real world and automatically applying this to the game world. At the other extreme the player can determine how the real world data is applied in the game world, micromanaging game interactions.

The player may choose to manipulate their actions in the real world to generate data required to progress more successfully in the game. Alternatively they may ignore the consequences of their actions in the real world and allow data to gather without consciously changing their behaviour. The player experiences a game induced mood while playing. This is an ambient game.

The game Ambient Quest is a (low cost) simulation of an ambient game. The data gathered from the real world is the distance walked by the player (measured with a pedometer). This distance is converted into the distance the player's character can travel in a virtual game world. Hence the distance travelled determines the number of activities, or quests, that can be completed. The player can either let the game randomly choose the direction the player character moves (and hence the quests attempted) or can select where the player character travels and hence which quests are attempted.

In live action role playing (LARP) games a group of players gather and take on game roles, acting out the game in a real world location. This is different to the proposed ambient games in which the actions of players in their everyday lives affect events in the game world. An ambient game is coincident with real life; elements are superimposed on the real world.

In a live action role playing game the players must make a large commitment of time and attention to the game. In an ambient game the game-play is in the background, available for the player to focus their attention on it. In the LARP and other types of game the player has information 'pushed' at them, they are required to interact. In an ambient game the 'pulls' information from the game when they want it. Ambient games feature pull, not push, technology. Compare this to ambient music which is composed to be in the background, though the listener can bring it to the foreground and focus their attention on it if they wish.

At the heart of ambient games is the idea that the players can dip in and out of the game; that the game is running in the background, creating as mood, while they are engaged in other activities.

## 5. AMBIENT GAME TECHNOLOGY

There are two possible ways that an ambient game could be implemented; either the player carries an ambient gaming system around with them or the game is embedded in the environment that surrounds the player. For a truly ambient game the interface should be unobtrusive, allowing the player to easily switch between engaging and ignoring it. An ambient intelligent environment offers an ideal solution for the implementation of ambient games. There are a number of technologies and ideas that make the production of an ambient game possible.

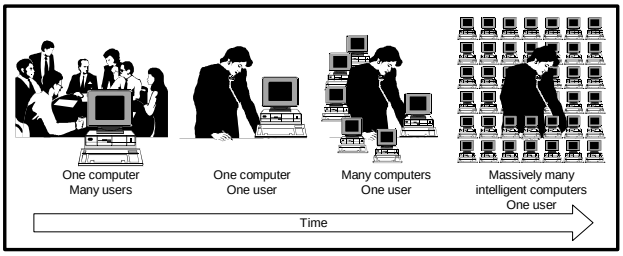


**Figure 3. Evolution of computer technology**

By considering the evolution of computer technology from the difference and analytical engines, designed by Charles Babbage from 1821 (Hackmann, 2005) through to modern day computing it is possible to get an idea of developments that are enabling the development of future ambient intelligent environments. The increasing computing power that has been key in making advances in computing possible was described by Gordon Moore in his 1965 paper in Electronics magazine, his now famous 'Moore's Law'(Moore, 1965), where he predicted that the number of transistors on a chip would double every two years (Twist, 2005). This has proved to be a conservative estimate with the rate of increase nearer to doubling every 18 months. Consequently it seems likely that computing power will continue to increase.

On the 6th May 1949 the EDSAC 1 (Electronic Delay Storage Automatic Calculator) ran its first program and became the world's "first complete and fully operational regular electronic digital stored program computer" (Jones, 2001) and computers started to enter commercial service. There were many users supporting each computer, the Cambridge computer laboratory staff list for 1948 contained fourteen people (ibid), though the computer was of interest to many more, who did not have access to their own computers. This was the age of 'one computer – many users'.

In 1981 IBM introduced the 'personal computer' or PC and computers rapidly found their way onto desktops worldwide (IBM Archives: 1980s). The age of 'one computer – one user' had arrived.

By the turn of the century computers had pervaded western industrial societies. People in regions like North America and Western Europe came into contact with many computers daily. For example the authors of this paper interact with many devices containing computer systems daily: home desktop PC, work desktop PC, car (car engine), mobile phone, mp3 player, television, satellite receiver, DVD player, dishwasher, microwave oven, rowing and exercise machines and games consoles. Many of the devices listed are networked to other systems, exchanging information and tapping into even larger computing resources. Currently we are in the age of 'many computers – one user'.

Mark Weiser defined ubiquitous computing on his Xerox Palo Alto Research Center web page in 1996 (Weiser, 1996). He specified that there should, for example, be hundreds of wireless devices in an office that are invisible to the user. Invisible

meaning that the system does not demand the user's attention, it is "…so imbedded, so fitting, so natural, that we use it without even thinking about it" (ibid).

The increasing power of these ubiquitous systems, the development of new intelligent interfaces is allowing the development of ambient intelligent environments. Ambient intelligence is being driven by interaction technology (new ways of using content, such as time shifting television programmes on hard drives, and new technologies, faster computers, greater storage and so on), experience economy (people do not just pay for goods, but for the experiences that are connected with them, for example eating at an exclusive restaurant) and ambient culture (the development of social groupings based on interests rather than on a geographical basis, for example virtual web special interest communities, like the Independent Digital Games Research Association at http://www.digra.org/) (Aarts, Harwig, Schuurmans, & Denning, 2001).

There are a number of different technologies that are enabling the development of ambient intelligence: interconnectivity, artificial intelligence and the proliferation of computers. These technologies support the ubiquity, transparency and intelligence of ambient intelligence (ibid).

Ubiquity refers to ubiquitous computing in which a massive number of interconnected computers are embedded in the environment.

Transparency indicates that ambient intelligence environments are invisible and in the background (ibid).

Intelligence relates to the interfaces and ways these interconnected computers respond and interact with people through user friendly interfaces. They are able to "exhibit specific forms of social interaction" (ibid).

The European Union's Information Society Technologies Advisory Group (ISTAG) predicts that ambient intelligence will emerge from the convergence of three key technologies:

- Ubiquitous Computing
- Ubiquitous Communication
- Intelligent User-Friendly Interfaces

(Weyrich, 1999)

The research division of the Netherlands company Royal Philips Electronics (Philips) has determined that ambient intelligence should have the following characteristics: context awareness, personalized, immersive and adaptive (Philips, 2004-2006). Context awareness entails devices knowing where they are and responding appropriately; for example a mobile phone might automatically switch to a silent profile when carried into a cinema. Personalized devices are able to deliver information and experiences tailored to the user. For example, a portable device carrying games and music selected by the user and also monitoring the user's health. This definition is far reaching in places and also clearly aimed at supporting Philips' products, such as their 'Ambilight' television technology in which a light located at the rear of televisions react to the colours and brightness of images on the screen. However it is a very strong indication of the acceptance and future growth of ambient intelligence.

Ambient intelligence systems may also require locative information, specifying player location and also assigned identity and/or personal identity knowledge, they may need to differentiate between different people. For example if one of the functions of an ambient intelligence is to control the lighting within a house it not only needs to be able to turn lights on and off as people move through the house, but also set brightness levels according to the preferences of individuals.

In order to fulfil the transparency requirement communication with ambient intelligences should be seamlessly integrated into the environment. Computer workstations or input panels do not fulfil transparency. The user might expect to be able to communicate with ambient intelligences through speech or gestures, with the ambient intelligences responding in speech or with their available interfaces (perhaps momentarily dimming lights to indicate that a request has been received and stored).

As devices proliferate it becomes useful to be able to identify them. Different components in ubiquitous systems need identity in the same way that in games each of the non player and player characters need identity. If there was no way of identifying individual components then it would be impossible to know the outcome of interactions.

Items may be tagged in the physical world with Radio Frequency Identification tags (RFID) tags. These are transponders that respond with a unique serial number when a reader sends a signal to them. They are frequently used for tracking goods through supply chains, where it is useful to know the location and identity of the goods (RFID Centre, 2005).

People may be tracked in the real world using face recognition systems (Zhao, Chellappa, Rosenfeld, & Phillips, 2003). This recognition has great implications for ambient intelligence environments where they might be used to recognize and track people as they move around and also to ensure that the systems respond appropriately to known individuals. (Grgic Ph.D, 2006)

With the emergence of ambient intelligence and ambient intelligence environments the age of 'massively many *intelligent* computers – one user' is arriving and bringing with it new gameplay opportunities.

## 6. AUGMENTED REALITY AND PERVASIVE GAMING

The introduction of existing, commercially available, devices able to track the position of people in the world, such as global positioning systems, is opening up many opportunities to explore new ways of playing games, for example augmented reality and pervasive gaming.

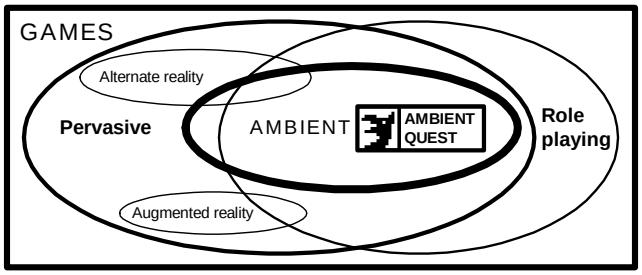


**Figure 4. Pervasive, ambient and role playing games**

Players of augmented reality games wear a head mounted display that allows them to move around the real world with computer generated images superimposed onto the real world. The equipment tracks the player's location and where they are looking then generates appropriate images.

Examples of augmented reality games include Pac Man at the Mixed Reality Lab, Nanyang Technological University (Human Pacman, 2006) and ARQuake at the University of South Australia (Thomas, 2002).

Augmented reality technology gives one route forward for gaming in the environment, but still requires the user to carry equipment around with them. In its current incarnations augmented reality requires the user to make a substantial commitment of time and effort to play the game and consequently does not sit within ambient games.

Pervasive games are a type of locative game in which players (though not necessarily all of the players) move into the real world while playing and their position and actions in the real world affect, and are affected by, events in a virtual world (Waern, 2006). There are a number of different variations on this; the IPerG research consortium lists the following areas of pervasive gaming that they are exploring:

- Crossmedia games
- Socially adaptable games
- Massively multiplayer reaching out
- Enhanced reality live role-playing
- City as theatre

(ibid.)

These vary from ambient games in the commitment the player makes to the game and the intention of the game; the intention of ambient games is to create a mood in an environment. The games listed above also frequently require the player to carry around hardware for playing the game.

The mobile game Feeding Yoshi was presented in 2006 as a game that exploited 'seamful design'. Seamful design incorporates discontinuities (gaps and edges) in ubiquitous systems (wireless and global positioning coverage, for example) in applications, including games. (Chalmers, 2003) In Feeding Yoshi the players (working in teams) each carry a PDA as they go about their normal lives. When they are within range of a 'plantation' or Yoshi the PDA beeps and displays details of the plantation/Yoshi. The player can then plant seeds, harvest fruit in the plantation or feed the virtual Yoshi character. The plantations and Yoshis are generated within the PDAs based on the type of wireless networks detected – secure networks become Yoshis, open networks become plantations. Players can further swap seeds and fruit with each other (Bell, 2006). Feeding Yoshi is an interesting example of a game in which players play while going about their normal lives. However in order to play the game the players have to focus their attention onto the implementation of the game on the PDA where they carry out particular game moves; further the game calls their attention, pushing them into the game to make moves when appropriate networks are detected. Although players have a choice of whether to play or not, this game does not share the ambient ignorability of ambient games, in which play is possible without focusing attention on the game.

In 2005 'ambient utility games' were proposed by Sonja M. Kangas and Outi I. Cavén-Pöysä in which playfulness is introduced into experiencing and understanding information, especially using innovative interfaces to allow player movements and so on to feed into the game (Kangas, 2005). The purpose of these games is not only to entertain but also to have a utility, or usefulness, to them, encouraging players to perhaps exercise or study: "Utility games belong to a new type of game where utility is emphasized in the content" (ibid). They further suggest using pervasive technologies to realize these games. The emphasis on utility sets these apart from the ambient games such as Ambient Quest where the primary intention is to create a mood, not to create useful behaviour in the player; though as a by product of playing a game like Ambient Quest the player may engage in useful behaviour. In the conclusion to their paper Sonja and Outi do specifically mention leisure gaming as an application of their ambient utility games, though this does seem to contradict the emphasis they place on usefulness and education elsewhere in the paper.

Alternate Reality Games (ARG), sometimes known Cross Media Entertainment – (XME), are according to an article on CNET News.com:

"...an obsession-inspiring genre that blends real-life treasure hunting, interactive storytelling, video games and online community..." (Borland, 2005)

The Alternate Reality Gaming Network defines alternate reality games as "an intensely complicated series of puzzles involving coded Web sites, real-world clues like the newspaper advertisements, phone calls in the middle of the night from game characters and more. These games (which are usually free to play) often have a specific goal of not only involving the player with the story and/or fictional characters but of connecting them to the real world and to each other. Many game puzzles can be solved only by the collaborative efforts of multiple players, sometimes requiring one or more players to get up from their computers to go outside to find clues or other assets planted in the real world." (Alternating Reality Gaming Network, 2002-2006) Unlike augmented reality games they do not normally require special equipment to be carried around by the players while they are being played, though players are likely to need access to computers, phones and other sources of information.

Many alternate reality games are used for promotional purposes, for example the first alternate reality game, The Beast, was used to promote the film AI: Artificial Intelligence in 2001. More recently, 2006, Volvo cars has used alternate reality game 'The Hunt' to promote the release of a new XC90 car (http://thehunt.volvocars.net/uk/thehunt/). The alternate reality game Perplex City (http://www.perplexcity.com/) is not a promotional tool, but makes money from selling clue cards to players. As well as clue cards Perplex City also delivers puzzles and clues via websites, podcasts, emails, texts and live events.

Alternate reality games combine events in virtual computer spaces and the real world to create a coherent gaming experience. They are frequently multiplayer, requiring co-operation between two or more players to solve puzzles and progress. The unfolding stories in these games blur the boundaries between reality and fantasy by incorporating game elements into the real the world that influence game play in online worlds.

Alternate reality games are very close to ambient games, but still require a commitment from the player and demand specific game playing behaviours. They are not driven purely by normal everyday behaviours.

Ambient games are related to augmented reality, alternate reality and pervasive games. Although ambient games are likely to use computer game technologies, they are different from computer games.

## 7. DEFINING AMBIENT GAMING

Ambient gaming has been specified in relation to ambient music and the technologies that would make ambient gaming possible, in particular the development and nature of ambient intelligence environments had been described. Although ambient games are likely to include computer game technology to create their virtual worlds they are not the same as traditional computer games. New ways of playing computer games in the real world, such as augmented reality gaming, pervasive gaming and alternate reality games have been described in order to set the idea of ambient games in context.

Ambient games can be defined as games that are controlled by everyday actions (i.e. not using a dedicated game input device, mouse or keyboard) in everyday, real world environments that have gameplay consequences in a virtual game world. Further, ambient games do not demand the attention of the player, they are 'ignorable as they are interesting' (Eno, 1978), allowing players a wide depth of interventions from letting the game play itself to micromanaging game events. Ambient games are always 'on', the player does not experience them in isolated, discrete playing sessions as is the case with, for example, console games. Ambient games also allow the player experiences that range from superficially shallow to profoundly deep. The player is able to choose how they focus their attention on the game, and alter their degree of attention at will. A key attribute of ambient games is their intention and ability to create a mood in an environment.

Ambient games are coexistent with the real world and may be seamlessly controlled by the intelligent interfaces of ambient intelligent environments. They are intended to influence the player's experience of their environment, perhaps invoking emotions through the game that affect the player's perception of the real world. The ambient intelligence interfaces give information (feedback) on the progress of player characters (avatars) and allow the player to interact with the game's virtual world through gesture, speech and movement. In some applications of this game technology the player's heart rate, respiration and so on might also be used to control their avatar, rather like Dan Sutch's Fizzees (Tamogotchi like digital creatures that are nurtured by the physical actions of their owner) (Sutch, 2006). In other applications it may be things that players do in the real world such as moving around, spending money and so on. The feedback to the player may not necessarily be limited to auditory and visual senses, but might also affect other senses, perhaps creating temperatures, smells and so on.

The ambient game definition allows for single player, multiplayer or massively multiplayer gaming. The number of players does not affect the 'ambience' of ambient games.

## 8. IMPLEMENTING AND RUNNING AN AMBIENT GAME SIMULATION

The game Ambient Quest is an example of a simple, inexpensive single player ambient game simulation. Ideally Ambient Quest would be played in an ambient intelligent environment with a sophisticated 3D virtual world and intelligent interfaces and many more aspects of the players' activities would be mapped onto their avatars, perhaps in a massively multiplayer version of the game. However, in order to test out some of the ideas of ambient games with a moderate budget Ambient Quest has been designed to be played using a simple 2D virtual world and the ambient intelligent environment has been somewhat simplified, being simulated by carrying a pedometer to measure distance travelled. A more successful implementation of this might use cameras embedded in the environment and face recognition software etc. to measure distance travelled. However, in the current implementation of Ambient Quest the number of steps taken by the players is used to determine distance travelled in the virtual game world. Players enter these distances into the game by giving them to the researcher (in person or via email) who takes on the role of the intelligent interface and enters the distances manually into a game engine that then provides a log file that may be used by the players to display the activities of their avatars.

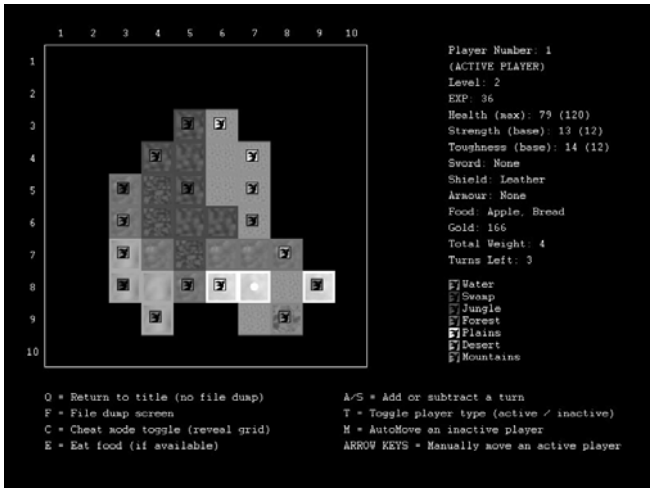


**Figure 5. Ambient Quest screen layout**

The limitations of this system are that the players have to make a little more commitment to the game than might actually be necessary in an ambient game implemented in an ambient intelligence environment.

In addition to supplying the distance walked there are two ways for players to control avatars. Firstly the avatars move in random directions, without player intervention, automatically fighting enemies they encounter and so on. Secondly the player may decide the direction their player character travels, and hence determine the occurrence of fights and so on. These directions are supplied to the researcher with the distance walked for entering into the game engine. For convenience these two modes of play may be termed 'passive' and 'active'.

The virtual game world comprises a two dimensional grid. Player characters can move north, south, east or west (not diagonally). If they pass through a square containing a pickup then this is automatically picked up and any actions triggered by the pick up are resolved immediately. If they pass through a square containing an enemy then they automatically enter into combat, which is resolved by comparing player 'attack' against enemy 'defence', modifying the outcome with a dice roll. If the enemy is defeated then there is a chance it will drop something the player can take.

Ambient Quest was run at the Women in Games 2007 conference on the 19th and 21st April 2007 at University of Wales: Newport, United Kingdom. The conference was attended by academic game researchers and industry professionals. The delegates were all given pedometers and computers were set up with the Ambient Quest program running on them so that distances moved could be converted into game moves.

The delegates quickly became engaged in the game and it did seem to influence the mood at the conference, or certainly pervade the conference, with delegates talking to the author about the game. The attention of players on the game varied greatly over time; they were able to ignore it or focus more fully on it at whim. Players also admitted to changing their behaviour, for example walking instead of getting a taxi. Players also 'cheated' by shaking their pedometers. This was sometimes justified because pedometers had been accidentally reset. The pedometers had a reset button on the outside (see Figure 6 below) which was rather easy to press.


**Figure 6. Pedometer**

The positioning of the reset button resulted in 'game modding' as players started pulling the buttons off the pedometers so they could not be accidentally reset. This pedometer modding was unexpected, emergent, game behaviour that had not been predicted. Over the second day of the game players were talking about how far they had walked and discussing how far they 'should' walk each day.

During the second day a couple of people asked to have their moves put into the Ambient Quest game program, but this was a much smaller number than was expected (the game was installed on four or five computers and one of the student helpers was prepared to run the game).

Despite this low engagement with the virtual world it was very clear from conversations with people that they were aware they were playing a game and that their movements would affect movements of an avatar. There was a very strong sense that people were engaged together in an ambient game as evidenced by their comments.

By the third day it had become clear that the delegates were largely not interested in the process of transferring their pedometer readings into the Ambient Quest 2D world though they did continue to refer to the game. They already had a good idea of the gameplay and it was as though they didn't actually need to go and see it played out on a screen. They could imagine it, which may not be surprising considering the conference delegates were mainly game researchers and developers. Additionally the conference had an extremely full program; there were a lot of distractions and lively networking between delegates.

One of the speakers at the conference, Julia Sussner, made an interesting observation about the way people were reduced to 'steps'. The 'steps' to 'squares' transfer when using the pedometer reading to determine moves on a 2D map involved a numerical to graphical transformation. Perhaps there is a sense of enlargement when taking the scalar steps and using them to create vector moves. In his book 'Little, Big', John Crowley (Crowley, 1981) describes a world behind our world in which 'the farther in you go, the bigger it gets'. Beyond the moves on the 2D map there is an avatar with attributes, armour, weapons, supplies, gold, experience and so on. The deeper the player moves into the game the more complexity they will find and the richer the game experience, which might lead to a greater the influence on the real world.

The stated aim of this ambient game was to create a mood at the conference and to be as ignorable as it was interesting. The game needed to allow players to determine their own levels of commitment, from ignoring the game to fully engaging with it. Ambient Quest delivered on this with conference delegates lying on a spectrum from superficial to full engagement.

Would the reaction of the delegates have differed if they had just been handed pedometers without a game attached? Observations and conversations lead to the conclusion that the players would not have been as engaged; there was a definite buzz at the conference that something novel was being tried and that something was happening just out of sight, driven by the pedometers everyone was wearing. The delegates were playing a game, not just measuring the distance they walked.

## 9. THE FUTURE OF AMBIENT GAMES

Future research in ambient games is planned to reveal not only their use as a form of entertainment but also their more serious uses, in line with the ideas mentioned previously on ambient utility games. Imagine a job which involves fairly repetitive actions which are not in themselves especially rewarding. Could an ambient game be designed that ran alongside this work and brought an element of playfulness to the job? For example, imagine an ambient game that drew its data from supermarket shelf stacking, with employees belonging to different teams that were represented by competing avatars in a virtual world. If ambient games are proven to modify behaviour then they might be designed to have a direct effect on productivity, rewarding productive work practices. Outside of the workplace ambient games might be used to encourage healthy life style choices, perhaps increasing the amount of exercise that people take. The Ambient Quest game has been shown to affect simple choices such as whether to walk or take a taxi. This simple ambient game simulation has been designed to be extensible and usable in future investigations.

## 10. CONCLUSION

This paper has described a novel way of playing games and has defined ambient gaming. The ambient music roots of ambient games have been described, showing how the former informs the latter. The growth of technology suitable for implementing a full ambient game system has been described and this has been contrasted and compared with existing game technologies including both augmented reality and also pervasive gaming. A way forward for research into ambient games has been suggested with the description of playing a simple ambient game simulation, Ambient Quest, at a conference. Future applications of this exciting (ignorable as it is interesting?) technology have been suggested, showing that this is not only of theoretical interest but may have a significant impact in serious gaming areas.

Ambient games signal a move into a more playful future, an age of playfulness, where people may, invisibly, play games and where playfulness is able to enter and integrate with our everyday lives.

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