

# Designing Ubiquitous Computing Games – A Report from a Workshop Exploring Ubiquitous Computing Entertainment

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**Abstract:** We report from a Research Atelier that explored how ubiquitous computing could be applied to fun and entertainment. The Atelier lasted for five days, starting with two days of scenario development and brainstorming activities. This led to three fairly concrete – though very different – game ideas. The background and motivation for the Atelier is described, as well as the method used and the games developed.

**Keywords:** Computer-based entertainment; Computer games; Game design; Ubiquitous computing

## 1. Introduction

The rapid spread of mobile phones throughout the 1990s and the recent investment in 3G technology has sparked a significant interest in mobile gaming, including games that rely on information about players' location as part of the experience (cf. Nokia Game, Bluefactory, Pico-fun and Botfighters). Other handheld devices (e.g. Cybiko, Gameboy Advance and Game Park GP32) providing a wide range of available platforms for networked, mobile games. At the same time, computer game developers have been exploring how to incorporate live data from the physical world into virtual environments (e.g. Black & White, where the virtual weather changes according to the actual weather where the game is being played). Attempts at truly multimedia games have been launched by computer game companies (such as Majestic by Electronic Arts) that make use of multiple heterogeneous devices such as mobile phones, fax, email and the Internet.

We see all these developments as the first steps towards creating fully ubiquitous computing games in which participants on the ground and online participants share a common experience. However, we also believe that we need to

go beyond using only very specific end-user devices, such as mobile phone handsets and handheld gaming consoles, if the true potential of ubiquitous gaming is to be unleashed. Even a Java-enabled mobile phone has inherited most of its affordances from a traditional telephone, and it is mostly optimized for making phone calls, not multi-user games intertwined with the real world.

Besides coarse positioning, most current computer-augmented games make little use of the real-world environment as an intrinsic and meaningful game element. Wishing to explore the possibilities of new sensor and actuator technology in a game context, we organized an extended workshop where researchers from the field of ubiquitous computing worked for several days with the aim of creating a number of proof-of-concept designs. The workshop aimed at bringing together people interested in exploring ubiquitous gaming, games where players' real-world context is influencing the (computer-controlled) game play. While ubiquitous games are situated and played in a real environment, much in the same sense as traditional games, their game play is augmented in real time by computational services, to enhance and leverage the overall gaming

experience. In this article we report the results from that workshop, starting with background to the workshop, methods used and related work. We also describe some observations made at the workshop, and the three different working groups each describe the games they developed during the event.

## 2. Background

Since January 2001, the EU has funded the Disappearing Computer (DC) Initiative, a proactive initiative of the Future and Emerging Technologies (FET) activity of the Information Society Technologies (IST) research program to investigate how ubiquitous computing and similar technologies can affect all aspects of people's lives. As stated on the project homepage, "The mission of the initiative is to see how information technology can be diffused into everyday objects and settings, and to see how this can lead to new ways of supporting and enhancing people's lives that go above and beyond what is possible with the computer today." (<http://www.disappearingcomputer.org>). Seventeen research projects have been funded by the DC initiative to fulfil this mission. To further reap benefits from the projects, a specific budget has been created to enable collaboration and information transfer through a number of different intra-project activities such as workshops and one-day meetings. No project within DC specifically addresses entertainment or games and we therefore proposed to explore the area within the context for the DC in a joint workshop, a so-called Research Atelier. The workshop would focus on merging ubiquitous computing and games with the goal of producing a number of actual game designs and prototypes. A Research Atelier was ideally suited for this, as 'these are small budget and short time scale projects (<3 months, typically 7–10 days) which merge ideas from different projects, help build new consortia, or encourage new developments. These ateliers reflect a philosophy of "putting the work back in workshop, where real tangible results of mutual interest and benefit to the DC community can be developed" (<http://www.disappearingcomputer.org/activities.html>).

## 3. Goals and Methods of the Research Atelier

The goal of the workshop was to bring together creative and driven people to exchange experiences and ideas about expanding the domain of ubiquitous computing to computer entertainment. The long-term goal was to find a group that could form the nucleus for a research community. More explicitly, the following four goals were set for the workshop:

1. Gain experience in the designing of ubiquitous computing games by the creation of a number of prototype systems.
2. Create a network of researchers interested in the field within the DC community.
3. Gather and disseminate information about academic and commercial developments related to ubiquitous computing games and entertainment.
4. Exchange methods, techniques and technologies usable for future research in ubiquitous computing games.

Our aim at having a number of game concepts, and even prototypes, was the primary requirement that directed the working process of the workshop. Thus, we wished to quickly get the participants to work together in small groups towards a common goal and to work on a practical level. A scenario session would give us this focus and also be a good starting point. The organizers had previously used this method [1,2] in workshops where a number of people from different disciplines quickly have to create a common mental model of a possible future. Briefly summarized, the method consists of the following points:

- Identify a focal issue and determination of valid time frame.
- Identify key factors.
- Search for the 'unknown' driving forces behind the key factors.
- Organise driving forces in scale of importance and uncertainty.
- Pick important and uncertain forces and create a scenario matrix or a few scenarios by combining driving forces.
- Evaluate the focal question in each scenario.
- Identify indicators which tell in which direction the environment is heading.

Typically, most of these steps are done in subgroups, which present their results for the other groups before proceeding to the next step. For this workshop, we chose to modify the method by leaving out the two last steps and instead letting the participants engage in a design phase. Further, the first step was set by us before the workshop started to be “What will you do to entertain yourself after work/school/day-care in 2010?” We justified the modification by the fact that the scenarios were not to be used to answer a specific question or to try to foresee a possible future but rather to provide a backdrop for the design process.

The use of the scenario method had two advantages. First, the creation of future scenarios was something that was needed as the ubiquitous computing games were to be set in future environments and letting the participants create these themselves would let them feel involved in them. If the scenarios had been prepared before the workshop, we would have had to present and explain the scenarios to the participants, and would have to hope that they would find them appealing as potential settings for ubiquitous computer games. Secondly, the activity let the participants work together to create something that was outside their normal line of work, thereby avoiding risks of conflicts based upon the methods and theories used in their day-to-day work, at least until the groups had worked together for some time. Also, this highly cooperative work process between people from many different countries and from different research fields led to a development of a common mindset or mental platform for the following work with more specific game designs. It also helped to overcome some language problems and allowed for the participant to get acquainted.

The specific design processes used for creating the games were chosen by the groups themselves, although an overall framework and a set of tools were provided by the organizers. The participants were given the task of designing a game and making a half hour presentation during the last day of the workshop.

The organizers provided tools to facilitate a number of different design processes: ranging from whiteboards and post-it notes for brainstorming, to digital cameras and video cameras for documentation and scenario presentations, to hardware (microcontrollers, weather stations, alarm clocks, fingerprint readers, etc.) for actual

building of working prototypes. The availability of these tools was made possible due to the location of the workshop at the IT University in Gothenburg where a design studio has been created for the Masters program in Human-Computer Interaction/Interaction Design. In addition, a collection of recreational games with miniatures and toy figures, collectable card game cards, and toys were provided to function as well as props and as sources of inspiration.

Finally, the organizers of the workshop made themselves available as extra ‘muscle’ to the various groups during the whole design process, a notion that can compare to how designers are facilitators while users are players in the ‘design-by-playing’ method [3].

## 4. Related Work

Researchers have identified computer gaming as a useful prototyping area for exploring innovative metaphors, modalities, and hardware without having to fully develop infrastructures that would be needed in other applications [4]. Indeed, within the international research community there is a growing interest for studying how computers can be used for leisure related activities. Over the last few years, several international workshops have been organized around this theme: the ‘Future of Fun’ series [5,6], the ‘Designing Ubiquitous Computing Games’ [7], the ‘Computers and Fun’ series [8–10], and ‘Funology: designing enjoyment’ [11]. However, these have been shorter workshops (typically, one or two day sessions) where the focus have been on the conceptual level rather than grounded on the presently available technology.

Several projects have explored how to use location information to enhance computer games. *Can You See Me Now?* is a game that involves up to 20 members of the public as players logged in over the Internet, moving an avatar across a map of a city. The author is chased through the streets of an actual city by three runners equipped with handheld computers with GPS receivers communicating over a wireless network (Can you see me now?). *Pirates!* is a multi-player PDA-based game that was demonstrated at HUC2k in Bristol in 2000 and at SIGGRAPH in 2001 [7]. Radio-based proximity sensors are used to detect proximity to other players or ‘islands’ in the game. By making

players move through the physical environment to travel within the game, the presence in the game was superimposed on the presence in the real world.

Similarly, a number of experimental games have been created using virtual reality or augmented reality techniques. The MIND-WARPING system [12] uses computer game applications to explore aspects of wearable computing and augmented reality. In an example game, players used one of two forms of augmented reality, one with a first-person view and one with a third-person view, giving two different forms of presence within an augmented reality. The Mixed Reality Systems Laboratory has developed three augmented reality games: AR2 Hockey, RV-Border Guards [13] and AquaGauntlet [14]. Using high-precision body tracking and see-through head-mounted displays, virtual game elements are superimposed onto the player's worldview. Players see each other through their displays, with virtual helmets and guns rendered on top of their real-world appearance.

PingPongPlus [15] explores the concept of Computer-Supported Cooperative Play (CSCP), in which traditional games and sports are transformed and augmented. Using a sound-based tracking system and a ceiling-mounted projector to show graphics on a ping pong table, several applications have been designed that support both cooperation and competition. Although restricted to the location of a table, the system shows how one can augment a physical activity without having to equip users with hardware. False Prophets [16] is a hybrid game that uses a computer-augmented board game and handheld computers to create a game that requires non-mediated social interaction between the players. Computation is used to provide private information to the handheld devices and to create an action-for-energy system that frees the players from traditional turn-taking.

Most of the projects above developed games to explore the functionality of some technology. The purpose with our workshop was to explore gaming and entertainment, rather than a specific technology. Once the idea has emerged, a technology that suites the purpose is used or several are explored to find the one that suite best. In contrast to the other gaming and entertainment workshops that had the same

focus, how to create better games and entertainment ours were very practically oriented. We wanted to create mock-ups and prototypes and learn from those experiences.

## 5. The Research Atelier

The Research Atelier took place between the 18th and 22nd of February 2002 at the IT University in Gothenburg. Thirteen people participated which represented six different countries and seven different projects within the Disappearing Computer initiative with the addition of two master-level students from the IT University.

The workshop started after some administrative issues with a presentation of the scenario method to be utilized and the schedule for the week. This was followed with the actual scenarios session focusing on "What will you do to entertain yourself after work/school/day-care in 2010?" The session was intended to broaden the mindset of the participants and used a scenario method (cf. Holmquist and Mazé [12] for a similar use) that would form a background environment for the actual game designs. During the second step of the scenario method a large number of key factors were identified and from these a number of driving forces were selected. Taking the driving forces that was foreseen as the most important ones (introvert/extrovert, long-time/short and brief relationships, strong/weak self expression, social/ economical/political/educational gap, mass consumption/everyone is a producer) each group created a two-dimensional matrix with one driving force on each axis indicating if the influence was strong or not. Each quadrant in these matrixes made up a future society where the driving forces played different roles (see Figs 1–4). Each group decided on one of all these societies, which would then provide the context in which the game or entertainment system was designed.

From this point of the workshop, the setting for the participants' design was set. Three different groups had to come up with a game or entertainment idea and continue to develop it further during the coming days. Each group had different ways of pursuing their work and in the following section each is described in more detail.

Much of the material provided was used, e.g. the game miniatures were used both as actual

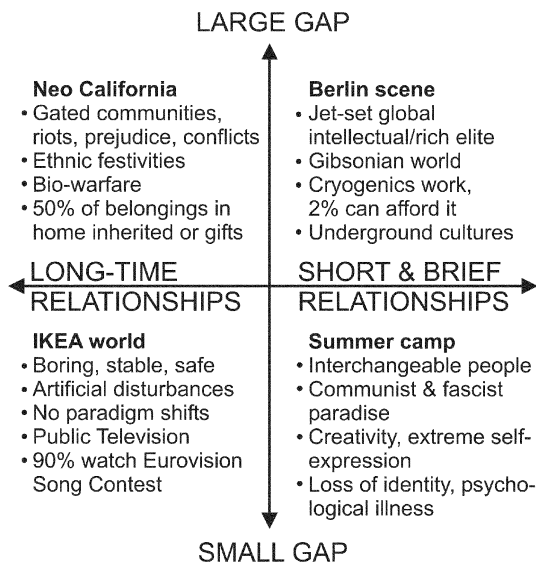


Fig. 1. Long-time versus short and brief relationships.

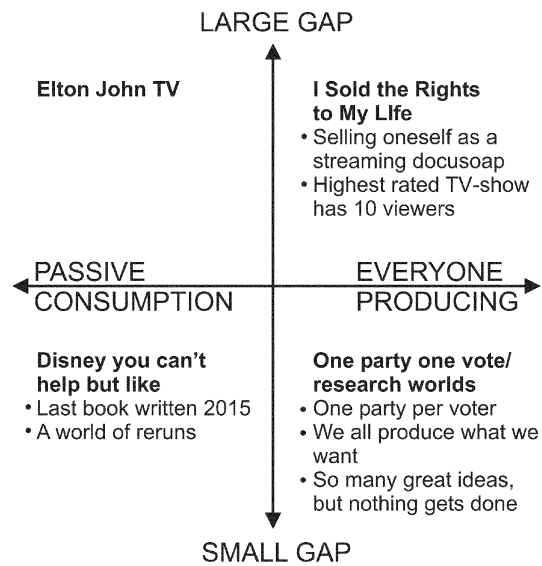


Fig. 3. Massive consumption versus everyone produces.

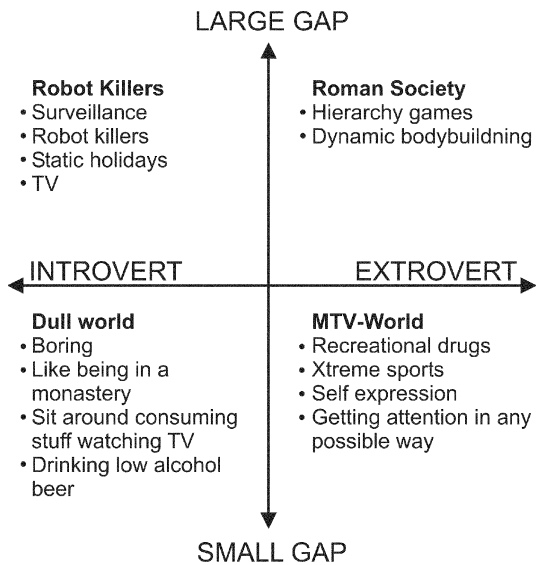


Fig. 2. Introvert versus extrovert.

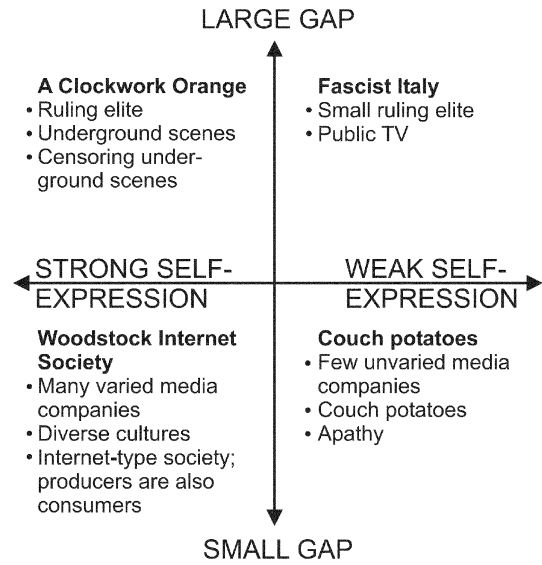


Fig. 4. Strong versus weak self expression.

game components and for representing players in games that took place on a city-wide scale. This use of props can be compared to the use of cardboard mock-ups used by Ehn and Kyng [17] and Brandt and Grunnet [18].

In the last day each group had to make a presentation. Although no specifics were given for how the presentation should be done, the groups invested significant effort into the presentations: one group created a detailed image scenario based upon pictures taken in the city of Gothenburg while another created a 10-minute video scenario showing the prototype in use.

## 6. Results

The atelier resulted in three very different games. The SpyGame is basically a catch the ball game, but on a worldwide basis, while the Multi Monster Mania is an extension of the today popular trading card games. The Guild is not a game in the sense of a competition, but rather a social game, it creates the base for fictional guilds among which different games or interactions can take place. In this section of the report, each group describes their game in terms of the initial game idea, how it was

developed and issues that came up during the development.

## 6.1. The SpyGame

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The SpyGame is a game played between a larger number of different teams that has one goal in common, to take control and deliver a suite-case.

### 6.1.1. The game idea

The SpyGame is based around one of the futuristic social scenarios that were suggested during the brainstorming session. The scenario suggested that there was a wide socio-political gap in a futuristic society that had evolved into two distinct groups. The first group were effectively the ruling class – they were affluent, well educated, had a large amount of money to spend on leisure time, but also not a huge amount of time for leisure, as they were too busy working. This distinguished them from the second group, who were said to be quite the opposite of the first group, in that they were poorly educated, had poor health and housing, and very little money, however as most of them were unemployed, lots of free time.

The first idea for the game was that it would be good to provide some way of allowing the two groups to interact, while at the same time providing the desired segregation between the two groups – the ruling class would not want, we decided, to mix with the other class, and would still want to exercise a certain degree of control over them. So, the basic premise of the game is that one group of people interact on a physical level, but are remotely ‘controlled’ in some way by a second group of people, to achieve a common objective. The common objective would be the ‘delivery’ of a parcel, with the remote users receiving more information as to the contents of it, and why it needed delivering. The second group of people, the physical players, only receive limited information, via their controlling equivalents in the first group.

This basic idea was developed into the following scenario: There are two teams of users, each divided into two groups, virtual or online players and physical players. The game

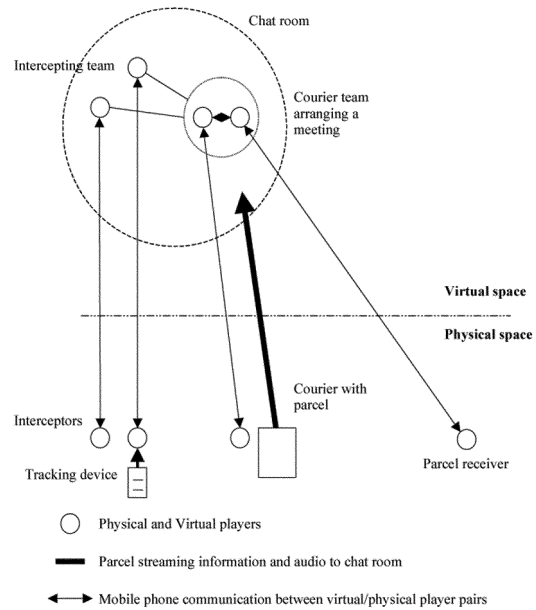


Fig. 5. The main areas of play in the game, and the flow of information between the areas.

revolves around one object, or package. The aim is to deliver the package from one physical player to another in a chain, in such a way that the package travels from one side of the game area to another – the game area could be a city, for example. One team is trying to make the package travel in one direction, while the other team is trying to make it travel back in the opposite direction. The team only has a limited amount of time to make the handover of the package, otherwise it will lock the current player out of the game, effectively handing the package over to the opposing team.

Each virtual player is twinned with a physical player, who they can talk to via mobile phones. The physical player receives instructions on where to go, and what to do, by the virtual player. The virtual player can coordinate their use of their own physical players with other virtual players in a virtual chat environment. This environment also provides extra information as to the whereabouts of the parcel to all of the virtual players, information that is not available to the physical players. This information is detected by the parcel, and then relayed to the chat environment.

As the parcel changes its physical location, different physical players are called in to play the game – obviously only players in the current locale would be able to take part, so the game

locates players that are in the right area, and distributes their contact details to the virtual players, their phone numbers for example. Physical players would register their locations and times they were available to play – obviously, it is beneficial for one’s team in one is available to play as much as possible.

Standard physical players play the part of spies, or scouts, merely relaying information back to their team. After the accumulation of game rewards, i.e. successfully taking part in the game, physical players may rent detection equipment – devices that give them more information as to the location of the package, and the ability to lock out its current carrier when nearby, again giving their team the chance to acquire the parcel. The standard physical players also have the ability to trigger the parcel’s locking mechanism, but only by reading a secret code on the parcel, which would be unlikely unless the carrier was very careless, and then relaying this code to the system.

The information broadcast from the parcel is not very precise, so as not to easily give away its location. It relays information including a continuous audio stream from its location, plus sensors give data on its ambient surroundings, for example, how warm it is, whether it is in light or darkness, the humidity, etc. There is a sensor on the handle of the parcel, so it can tell if it is being held or not. There is a fingerprint reader, which the courier must register their fingerprint with before being able to pick up the parcel. This enables the parcel to lock out users who have run out of time. Finally the parcel contains a positioning system, so it knows where it is. This information is not for the players directly, but to allow the system to figure out which players to involve in the game, based on the parcel’s location.

The chat environment consists of a public chat room, which virtual players from both teams inhabit. The only way two physical players can meet to exchange the parcel is by arranging a meeting through their controlling virtual players. The virtual players are given information about the area the game is taking place in, in the form of a map. The parcel broadcasts the data about its ambient surroundings into this chat room. The idea of the game was to involve some concept of espionage, or spying. The physical players have certain aspects of this in their half of the game, as they do not know which members

of the public in the same place are playing the game, or, if they are playing the game, which team they are on. To create this atmosphere for the virtual players, participants in the chat room can spy on other players while they talk. We proposed to facilitate this as follows.

Virtual players can send private messages to one another; however, there is a catch, some of the messages are also available for viewing by the chat room as a whole. From a one line message, up to half of the words, chosen randomly, are broadcast in their original order to the public chat area. This gives the opposition chance to try and work out where the meeting is going to be arranged. Obviously, this gives the team who are operating as the couriers an opportunity to spread disinformation, and thus enhancing the idea of not being able to trust any information you may receive from those around you for the virtual players.

### 6.1.2. Game Issues

To try and find out whether the above idea would be suitable for an actual game, we rapidly prototyped parts of the system, and then role played an example game, at first as a board game then to make a video.

To run through the game idea as a board game, we constructed a tabletop representation of a physical and virtual space, and then each member of the group took the role of a player playing the game. We then attempted to play a game, noting the interactions between players, and what information was transferred.

To see whether the technical infrastructure for the game was roughly feasible, we prototyped

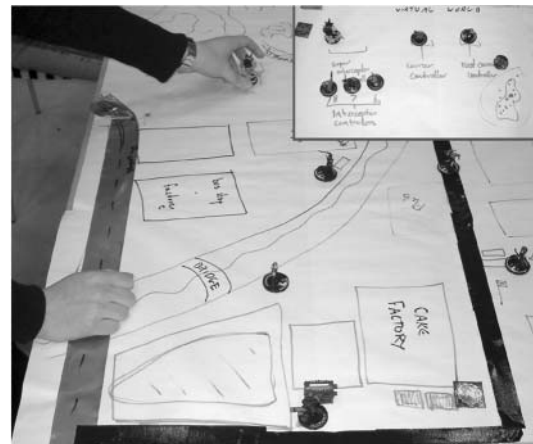


Fig. 6. Testing a fictional scenario with role playing.

two key pieces of the system. The first was the chat environment for the virtual players. This was a relatively trivial piece of software engineering, but it allowed us to test the mechanism for eavesdropping on private messages. The chat room client provided an interface that a game server client could join, that randomly picked physical player details from a database, and then distributed this information to the other clients.

The second was the parcel itself. This was as much an exercise in prototyping the physical design of the parcel as making sure all of the functionality worked. A briefcase was acquired, and enhanced in the following ways:

- Adding a kitchen timer – this is the time that the courier has remaining to deliver the parcel. The idea was to have this controlled by the lap top, but time restrictions did not allow this.
- Adding a flashing light – this is the alarm, when the timer reaches zero, the alarm will sound and the flashing light will flash.
- A laptop was stored within the briefcase. The aim eventually was to have this controlling all of the devices mounted on the briefcase, to act as a game controller. For this demonstration, the laptop was merely a client connecting to a wireless network, rather than acting a base station itself. For this a wireless wave LAN antenna was inserted in the skin of the briefcase, to allow good connectivity. This worked very well within the building, but it should be realized that the building had several wave LAN base stations installed anyway.
- An omni-directional microphone was discretely mounted in the skin of the briefcase, which was then connected to the laptop. The laptop relayed the audio stream over the wireless network to the chat environment, using the MASSIVE-3 audio server.
- A portable wireless weather station was inserted in the front of the briefcase. This relayed information to a base unit that in turn could be connected to a laptop computer. The laptop again implemented the chat client described earlier to crudely publish this data in the chat room.
- A finger print reader was mounted on the briefcase, but was not integrated into the rest of the system.

Our experiments showed the sensors in the briefcase did give some indication as to its location. Users in the chat room could here the voices of people in the same room as the briefcase, so it gave adequate audio coverage. Taking the briefcase outside caused a significant drop in the temperature, and placing the briefcase next to a running water tap caused a noticeable change in the humidity level registered.

### 6.1.3. The Result

The prototyped game seemed to meet many of the initial goals. The division of players into two groups, the virtual and physical players, fitted well with the concept of the social/economic gap. The virtual players make the high level decisions, and control the physical players and the overall flow of the game. The physical players are highly dependent on their virtual minder, while being the mechanism through which the game progresses.

The game provides opportunities for varying levels of involvement in the game. Virtual players have the opportunity to join the game at any time and from any place, and can become more involved by forging relationships with other online players and gaining recognition. Physical players can join whenever the game is close to their physical location and require nothing more than a mobile phone to play. Over time they can build a relationship with online players and are rewarded for playing with devices that assist them.

Using a mobile node (the briefcase) as the focus of the game supports this short-term, location based involvement, and also allows the game to run for a very long period of time, potentially indefinitely. It is, however, impossible to verify this since the paper mock-up only allowed a very limited subset of the game to be played, and the prototype was not playable. That said, they did allow for many elements of gameplay to be explored and developed and (with the notable exceptions of tracking the briefcase and identifying players to the briefcase) most of the software and hardware was functional.

The game, in its current state, demonstrated the basic concept well, but without further development it is impossible to say whether the game would function over a large area, over a long period of time, and whether the game-play can be balanced so that the game can move from



area to area to involve as many people and varied locations as possible without making it too hard to intercept the briefcase.

## 6.2. Multi Monster Mania

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### 6.2.1. The Idea

Multi Monster Mania is a card based game system featuring monsters that is set in a Gibsonian future with quite large social, political, educational and economical gaps. One of the ideas behind it is therefore that it should be possible for smart streetkids to create their own games or artwork for the game, earning some money on it. One also has the option to breed own monsters, selling the cards. The various incitements to engage in the game are thus to earn money, to have fun, to get an outlet for creativity and/or to collect cards. These incitements can attract players from any background; they will be attracted by different incitements, or rank them differently, but will nevertheless play.

Over the last couple of years, Personal Digital Assistants (PDAs) have decreased in size while increased in functionality and now come with color touch screens, short range wireless network connectivity (e.g. IR or Bluetooth) and a reasonable battery life as standard. Over the next years, we expect a further decrease in size combined with an increase in hardware complexity in the form of sensors that allow the devices to be aware of their immediate surroundings, such as the presence, location and orientation of other devices. The present game concept is based on the assumption that devices with touch-sensitive color screens and computational power equivalent to a current PDA in 6-8 years will be the size of a playing card, a couple of millimeters thick and cheap (on the order of a few euros).

Multi Monster Mania is a card game where cards have computational power that allows them to be dynamic and limited communication capabilities that allow them to interact over short distances. The game concept combines elements from traditional trading card games (such as Magic the Gathering) with that of the Tamagotchi to form a flexible game platform. In

addition, the game contains an evolutionary aspect that allows players not only to use the cards to play games but also evolve new cards suitable for particular games. Cards deemed valuable can also be traded.

There are four different types of cards: game cards, location cards, monster cards and modifier cards. Game cards specify game logic for a particular game, such as chess-type strategy games, Pokemon-style fighting games, peaceful doll-house type games or more traditional board games such as the Hatchery Game described below. Location cards embody a location (e.g. a desert, the magic forest, or Dracula's Castle) in which a game can be set. Monster cards contain the actual entities with which the games are played according to the rules specified in the game rule cards. Modifier cards can be used to modify any of the other cards and are used to represent for example weather (to modify location or game logic) or items (to modify the abilities of monsters). An actual game consists of a single game card and a set of cards of the other types. During the game, the cards interact according to the rules specified by the game rule card. All cards also carry a visual animated representation of their content on the front.

The monster cards are of particular interest. Each monster is identified by a genome that defines the monster's appearance and abilities, such as the number and types of arms, legs, eyes, etc. These characteristics determine how good a monster is at certain games. A monster with many legs and at least a couple of arms could perhaps be suitable for an American football game. In addition to the genome, a monster card carries a biography of the monster in the form of games played, training activities performed, ancestry, offspring, etc.

### 6.2.2. Design issues

Initial ideas included a game board carrying all the logic, combined with ID-tagged cards. This was abandoned, since it would be harder to exchange cards, since the code had to be transferred also. A kind of fantasy combat game was tried out; but turned out to be quite similar to existing games. The concept of a fantasy football game was also explored which led to the idea that card orientation could be significant in some games.

When we had come up with the idea of monsters whose physical appearance are deter-

mined by their genome, we experimented with a boxing application for monsters. This led us to consider how various non-physical properties, such as courage, could be derived from the genome. This is an interesting idea, that we never had time to develop.

### 6.2.3. The Monster Genome

A genome consists of a sequence of gene groups. Each group contains two types of genes: instance genes and modifier genes. The instance genes define the degree to which a certain characteristic is present in a monster. For a given type of instance gene, modifier genes can modify that characteristic. For example a monster with three eyes on sticks would have three 'eye' instance genes, and at least one 'eye on stick' modifier gene. There is an order of dominance in the modifier genes. For example if the 'human eye' gene is the dominant eye modifier, a creature with human eyes can also have the 'eye on stick' gene, but this would be suppressed by the dominant 'human eye' gene.

The genome is of variable length, and more complex monsters can have longer gene strings to describe their appearance. In trading card games it is common that periodically expansion sets of cards are released. These contain new cards, adding new options to the game. Our variable length genome gives us a great deal of flexibility for expanding the game after the initial release. Besides new games, locations and modifier cards, an expansion can contain new creatures that possess new properties. If these properties are useful, this will be an incentive for players to keep breeding monsters and integrate this new property into their existing group of monsters.

Breeding monsters is done by placing two monster cards and a blank card beside each other. (Monsters do not have genders as such.)

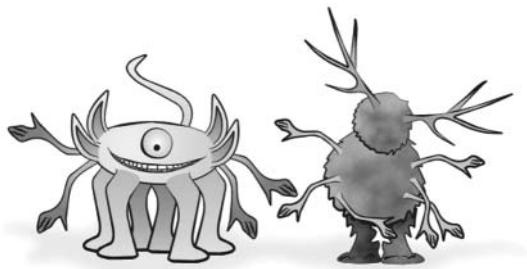


Fig. 7. Examples of monsters with different genomes.

When this is done, there is a chance that the two monsters will mate and produce offspring. The likelihood of the monsters mating depends on how similar they are. Similar monsters are more likely to reproduce than dissimilar monsters. To determine the chance, we examine both monsters' genome and count the number of common genes and the number of genes only found in one of the two. We divide the number of different genes over the number of common genes. The lower the resulting number, the more similar the monsters are. We determine the chance of reproduction by feeding this number into a function that only returns a high probability for low genome differences.

If two monsters mate, the following algorithm is used to determine the genome of the child. For each 'gene group', the genes of both parents are combined in a pool, and from this we select a random number of genes for the child. The probability of selecting a certain number of genes is determined by a bell curve. This ensures that if, for instance, both parents have two arms, the child will most likely have two arms but could have any number between 0 and 4.

The intention is that the reproduction algorithm will produce results that seem natural to the player, while still allowing for minor variations and the occasional freak result. By keeping the bell curve steep, we make sure that properties shared by both parents are copied in the offspring, while still allowing a slight chance that two two-armed parents will produce a four-armed child. When this happens, this may be very valuable to the player for certain games, or completely useless. We think this will keep breeding monsters an interesting aspect of the game.

The grouping of the genes is necessary to make the bell curve work. If the genes were not grouped, two two-armed and two-legged monsters could easily get a four-armed and zero-legged child. Of course, the fact that some genes may be recessive can lead to interesting results when the child turns out to have a property that both parents lack.

### 6.2.4. The Result

Effectively, Multi Monster Mania is a flexible and extensible game framework rather than an actual game. Games can be implemented in the form of game rule cards, and the monsters can be used as pieces in such games. An example of this

type of game is the Hatchery Game described below. The framework's evolutionary aspect provides a type of meta-game in its own right, the goal of which is to breed monsters that are either suitable for particular games or just plain interesting.

The framework is extensible in many ways. First, new games can be implemented and existing monsters used in them, even if the monsters did not exist when the game was developed. Similarly, new monsters can be bred and used in existing games. In addition, new genes can be invented by the framework designers. Although such genes cannot be inserted into living monsters, the breeding algorithm assures that monsters with new and old genes remain compatible and that offspring can have characteristics from both.

The remainder of this section describes the Hatchery Game, an actual game designed as an application of the framework, and discusses how this game uses the framework to implement functionality that would not be possible otherwise.

### The Hatchery Game

The game is played with teams of monsters and is set in an egg-hatching factory. Each player owns four eggs stored in an egg-hatching machine at the centre of the board, and the objective is to hatch one's eggs before the other players. Eggs come in four colours, and each team has one of each. When in the hatching machine, eggs grow or shrink depending on the colour of the machine – the closer this is to an egg's own colour, the better it grows, and finally it hatches. Monsters can change the colour of the machine by feeding pellets of different colours into it. Pellets grow in pellet fields located at the corners of the playing area.

Points are scored for hatching eggs – the sooner the better – and by cooperating with other players. The game evolves around the following:

- Getting pellets of the right colour and feeding them into the factory.
- Cooperating to get more pellets and points.
- Saving shrinking eggs by temporarily taking them out of the hatching chamber.

The game ends when all eggs have been hatched, and whoever has the most points wins.

To play, one needs the following cards:

- A rule card containing the rules for the game.
- Location cards; one game field entrance, pellet fields where pellets grow, as many hatching chambers as there are players.
- Monster cards; each player picks a team consisting of three monsters. Monsters with many legs and/or wings move faster, monsters with many arms can harvest and carry many pellets at a time.

The hatching chambers are laid out in a row in the centre to represent the egg-hatching machine. Other cards can be placed anywhere on the table. Distances between cards are virtual, and there is the same distance between all locations. In addition to the locations already mentioned, there is one extra location called the void, which represents the state of not being next to a location card. When a monster shall be moved, the player physically moves the monster card from one location card to another. At this point, the cards compute how long time it will take for that particular monster to perform the movement. Similarly, all activities take a certain time to carry through.

In addition to moving a monster card, activities can be indicated by dragging pellets in-between cards or an egg from the hatching chamber to a monster or vice versa. Typical actions include harvesting pellets from the fields, trading pellets, saving eggs, cooperating with other teams, and stealing pellets. While performing an action, the monster is considered to be busy and cannot be disturbed. Thus, the game is not turn based; players can activate any one of their non-occupied monsters any time.

The hatchery game contains many dynamic aspects that cannot be easily implemented using traditional board game methods. First, the dynamic and individual nature of the monsters is a vital aspect of the game. The timing of monster actions (such as travelling virtual distances, juggling eggs, harvesting pellets, etc.) subject to individual monster characteristics would not have been possible without computer-enhanced cards. The game environment itself also contains dynamic features that cannot easily be implemented with conventional methods: the continually changing colour of the hatchery, the constant effect of this colour on the growth and shrinkage of the eggs, the growth rate of pellets in the fields, etc. Also, it would not

be straightforward to keep the points attained by players secret for everyone until end of game.

### 6.3. The Guild

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#### 6.3.1. Background

One of the discussions brought up during the scenario exercise dealt with the question of broadening the interest and participation in computer games. Media companies, researchers and designers all seem to agree that computer games hold an enormous potential in the future. Certainly, new technologies have to be put in place in order for this potential to be realized. However, there is also another angle to this: computer games tend to remain a pretty well defined genre, with a huge and committed audience, but also with large parts of the population not particularly interested in them.

In terms of the Future Worlds defined in the scenario phase, the Guild did not use one of the developed worlds but envisioned a future world with the following characteristics from several of the worlds: *Strong self expression, Everyone producing, Extrovert and Short-term relationships.*

#### 6.3.2. The Guild Object

The Guild concept took its starting point in the notion of 'Guild Object', as explored in one of the previous exercises during the workshop. The Guild Object is a physical token worn by players. The Guild object helps players to recognize each other as friends or foes, and it enables players to bring the game with them out into everyday situations or environments. The Guild object could range from a piece of jewelry to a body implant, with some computational part, like a RFID tag. However, in the discussions around the Guild concept we came to realize that a 'plain' non-computational artifact could fulfil many of the uses of a Guild object.

#### 6.3.3. Play Communities

In continuation of the discussions about target groups for computer games, we started by discussing motivational factors in play and gaming – with a focus on those factors that are external to the game itself, such as need for

excitement or relaxation, identity and social networking. We spent quite some time listing various examples of 'play communities' i.e. social groupings around a shared repertoire of play activities. How do they work? Why do people participate? The list of organizations had functions ranging from social clubs, such as Odd Fellow and other free masons type organizations, to golf clubs, role playing organizations, religious sects and societies, such as the Moon Sect or the Church of Scientology, or organizations like Hells Angels and al'Qaida (the latter being not exactly 'play communities', but still interesting for the comparison).

In our informal brainstorm around these play communities some characteristics were recurrent:

- One of the main activities in a play community is to manage how new members get introduced and gradually become integrated in it. Secrets and the process of revealing them is important as a part of the process of initiations.
- The progression of getting to know the community, as well as rising in rank within the community, is an important motivational factor in participating.
- Shared stories, and even more, shared secrets are important in keeping the play community together. Secrets can be of many shapes: a sect member may be prohibited to communicate the revelations of the sect to a non-member, members of clubs for extra rich or talented people are advised not to display their talents/ riches in public, communities engaged in practices that are taboo or illegal stick together around knowledge that would hurt both members and association if it was made known to outsiders.
- Members of a play community form friendships and structures for mutual support that go beyond the realm of the play activity itself.

We also listed media and events these communities use in order to keep the organization running and progressing: Uniforms or various costumes, which often signify rank and status within the organization, parties and other social gatherings, initiation rituals for petitioners, secret handshakes or identities, symbols and tattoos to mark affiliation, address books or web sites giving members access to other members' personal contacts, various facilities such as club houses, systems for favors granted by fellow members.

### 6.3.4. Game idea

When thinking up our game, we wanted to exploit the very strong forces that are at play when people join and maintain memberships in these kinds of various organizations and networks. We also wanted to explore the notion of ubiquitous gaming, and create a game that is played by engaging with physical spaces and objects, using the everyday settings of the players as a part of the game experience.

The backbone in the Guild game is a narrative framework and a social structure that proposes a number of events and interactions to the players. We imagine heterogeneous uses for technological devices in the game – but these can be determined locally.

We explored a game idea along the following lines:

- a narrative backbone structure that proposes a series of events and interactions to the players;
- a network of ‘guilds’ where new guilds can be added to the game;
- a LARP (live action role-playing game) where the players’ everyday environments and actions take on a second meaning within the game context;
- Use of portable devices and new technology in the game (whether it will be a part of the structure or a part of the content is to be determined);
- Two overriding themes: competition between enemy guilds – management of new members within each guild.

#### The narrative framework

The following narrative framework for the Guild game highlights interesting issues but is not a detailed story, rather a set of logical devices to make if not believable so at least acceptable – in the terms of fiction – the assumptions of the game. Two rivaling alien species land on earth, both with the mission to conquer humanity and take possession of its planetary resources, and to do so before the rivaling clan. Both clans strive to create a new society extending their own, and built on their own values as adopted by their human followers.

They begin their quest by abducting members of the human race. The abducted humans are modified as to their physical and mental essences, and they start to work for the final takeover of power. However, waiting for the new



Fig. 8. A new member being abducted by one of the guilds.

society, the abducted humans continue to live their everyday life as usual, and the signs that a person has been taken over by the aliens are subtle. Only an initiated person can read them.

For the new abductee, a second life in parallel to their everyday life starts up. The first event is the abduction itself. Later, the new abductee gets initiated in the rituals and routines of the alien clan. When the abductee becomes sufficiently knowledgeable, he or she may be sent out on operations aiming to prevent the other clan from taking power, or to abduct new humans.

The ‘promise’ to the abductee is that they will rise in rank and position when the new leaders take over the world. You begin as a low rank citizen, and work your way through missions to gain higher positions. This rise is also expressed in the artefacts, clothes and symbols worn by the abducted persons.

#### User scenario

The following user scenario describes the concept not from the fictional framework but the realm of players of the game.

An interested person, Sheila, gets to hear about the Guild Game and wants to join it. Through friend, websites, or other information channels she decides which Guild to join. Sheila likes the graphical profile of the NKMRG guild, and she knows slightly some of the members – they are people she would like to hang out with. She contacts the Guild in question, and an ‘abduction’ is arranged for by the Guild. The abduction is seemingly a power overtake. In real terms, it can be described as a welcome party. At the Abduction, Sheila buys a token for the NKMRG Guild: a ring with an ID-tag containing her Guild Identity. It serves both to log in to the



Fig. 9. An example of a guilds graphical tag.

Guild website and to show her affiliation to other Guild players.

After the abduction, Sheila attends to NKMRR events once in a while. The club evenings are often mostly a social event, and an occasion to use the NKMRR costume – starting with the ring Sheila has gradually constructed/bought/collected a full costume for her NKMRR alter ego ‘Aliehs’. Some of it can be worn under regular street clothing without calling on the attention of non-players.

At her work, Sheila starts to notice some of her colleagues wearing Guild tokens. Some work colleagues also show interest in the game, and she later on introduces them to the Guild, after which they are ‘abducted’ as well. After a year, Sheila is responsible for arranging new abductions, which puts her into contact with a lot of new people.

### 6.3.5. Design Issues

The Guild concept was formulated in strong enjoyment. There are many issues in the concept that are not resolved – but this is also a consequence of the intention to focus at motivational factors external to the game itself. This division was of course difficult to maintain, and at some point we were all enjoying inventing new characters and fantastic guilds – really doing the work we had envisioned the players to do themselves.

There are some problematic issues in our concept that we believe are relevant for the genre of ubiquitous gaming overall, and that we would like to describe to open up for a discussion around them.

One issue is the idea of ‘giving up one’s free will’. On one hand this is a very useful device in

order to have players enter the game, and to help them forget about everyday obligations for a while. On the other hand, the idea of obeying a guild gives unpleasant resonance to totalitarian system or religious sects.

Another central idea in the notion of ubiquitous gaming is that it should be possible – and interesting – to play a game at the same time as doing some other activity. Ubiquitous technologies open possibilities to layer fictional landscapes on top of real places. But do we have the necessary intellectual and emotional capabilities to handle parallel lives/worlds? Does presence in one context (real or fictional) require absence in other context? Can a split mind enjoy a full experience?

In the workshop discussion there was a general agreement about identity building as an important driving force in play and gaming. But there is an interesting issue in the role of fiction in relation to identity. How far can ‘play’ identity building be pushed without spilling over into a persons ‘real’ identity? Are we ready to confront the real consequences of fictional identity building?

To summarize the different design issues:

- In designing a game there is a need to define and address the social strategies/motivational factors of the ‘real’ players of the game, in addition to that of the characters in the game.
- Ubiquitous gaming, i.e. game play not identifiable by a specific location or by a timeframe raises issues about how to distinguish play from reality.
- Any person’s choice of games (and of leisure activities at large) as a highly significant action in defining oneself and one’s social context.

## 7. Discussion

The workshop showed that there is great interest in Europe in the research community for exploring the use of ubiquitous computing for entertainment. It also demonstrated that with relatively few resources interesting concepts and ideas could be quickly developed though within such a short time it was impossible to perceive any deeper knowledge within the area. Even though the scenario method used in the workshop gave a structure for the workshop, in such short time the actual processes of designing the

game concepts was difficult to formalize as well as to find a common language to describe them. What methods can be used? What are the benefits of different methods? How do you describe these results?

Several researchers within the field of participatory design have proposed the use of games within the design process [3,19], and it could seem, as this would have been ideal method for the workshop. Indeed, many of the props provided were from games and most of the participants of the workshop were active gamers (within role-playing games, computer games, MUDs, board games, etc.). To use miniatures to role-play the citywide game on a table could be seen as some kind of game, but the group never described it as such themselves. None of the participants suggested a method based on playing a game to design the game. The use of setting up a game to create another game may have turned out to be counter-productive and confusing, as one would have to remember which game is which.

Scenarios, structural modeling of game mechanics, body storming, paper prototyping, rapid prototyping were all used but did not offer a way of discussing interaction and game play in a common language. It is our belief that the availability of such a common language would have made further refinement of the concepts possible by speeding up design discussions to allow further design iterations or testing.

Fortunately, there seems to be an interest among researchers and practitioners to develop ways of supporting the collaboration and communication when designing computer applications and systems for entertainment purposes. The Computer Games and Digital Cultures Conference (<http://www.gamesconference.org>) in 2002 presented work from the humanities to study games as its own subject with its own methods and terminology. Computer game developers have within their own forums proposed several theories and methods (c.f. Kreimeier's [20] design patterns and Church's [21] formal abstract design tools) to help design work and actively support research within the subject. By taking carrying on these projects and the more technically-oriented work presented in the related work section, and learning from the other fields, we believe that computer-driven entertainment can become as social and wide-spread as traditional games.

The workshop demonstrated the growing interest of ubiquitous gaming and entertainment; we hope to see more similar work in the near future.

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