When play is not enough: Towards actually useful applications for digital entertainment

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This article introduces a new form of digital entertainment, where playing is not limited to what can be done with the screen and the keyboard of a gaming device. By combining dimensions of the physical world and our social surroundings with computer-maintained game world, it is possible to design games with new levels of immersiveness. When adding elements of reality to the game play, it could be possible to find a useful link between computer entertainment and the real world. The authors believe that with sophisticated design, these new types of games could provide a platform for useful applications such as education, data gathering and the like, harnessing appropriate devices and networks.

Keywords: Pervasive game, trans-reality game, serious games, virtual world, real world. augmented reality

1. It is good to play

We and our companion species (Haraway 2003) like playing hide-and-seek, tag, hopscotch, just to give very few examples of the phenomenon that seems to be the same all over the globe (Heidenstam et al 1979). We enjoy the company of other people (and other species, such as singing birds), and we enjoy pleasant experiences. How could our pleasure-seeking activities be used for something that is actually useful also outside the game?

Playing traditional computer games is often seen as a relatively individual experience with little physical activity, where game events take place in 2D or 3D virtual environments viewed on the computer, PDA or mobile phone screen. Games on the market today show that no truly new game concepts have been innovated lately. According to Magerkurth et al (2004), this may indicate the dead end of design possibilities within the traditional computer entertainment paradigm.

However, a growing trend seems to be to bring physical activity and real world elements back to gaming, still utilizing the possibilities and benefits of computer electronics. These games, integrating physical and social aspects of the real world without the limitations and predictability of closed virtual environment, are referred to as *pervasive games* (Magerkurth et al 2004). Mobile technology has been essential in this development.

In this paper we will first examine different aspects of game-play experience, then explore pervasive gaming in terms of location and participants. A brief look into what is special about pervasive games is taken, and some possible uses of them outline are outlined. With pervasive games, we claim, the so called ‘serious games’ can gain new momentum, as we discuss some examples that could be actually useful for both the gamers, the sponsors and other parties.

2. Where do we play today?

Real world and computer games have both their own strengths. The strengths of the games played in a computer generated space or in the real world can be analyzed through four areas: physical, mental, social, and emotional (Nilsen et al, 2004). The enjoyment of sports and other real world games is based on the physical feeling of the game, improving technical skills and competition. On the other hand, the real world environment can offer a rich playground to support imagination and numerous physical objects to play with. How ever, a playground that is open for non-players is vulnerable to unexpected events that may disturb the game or harm the players' achievements.

Puzzles and strategy games and the like can offer a mental challenge. Within computers, the game world is artificially built and maintained by the computer. Changes in these virtual game spaces take place in a predetermined way, and everything can be anticipated, taking into consideration the built-in (pseudo)randomness. When compared to games in the real world, computer games can provide richer challenges to the player's mind, by adding, for example, simulations and complex gaming logic. In real world games, the rules are likely to be simpler and simulations need to take place in the player's mind. On the other hand, if a puzzle, for example, needs spatial reasoning, a tangible, real world game may be more playable than a computer simulation using two dimensional representations of three dimensional objects.

In real world team sports, such as football, the social aspect is strong. Nilsen et al. denote the interaction during the game, collaboration, and facing the opponent. Early computer games often had artificial opponents, but present-day online games enable even hundreds of thousands of players to participate the same game. In this way, social interaction has entered computer games. In real world games, social interaction might be more immediate and rich, but computer games may enable interaction with and by those who cannot participate in real world games due to location or disability. Massively Multiplayer Online Games (MMOG) are a special instance of the social interaction in computer games forming durable game worlds where the player can return to and where one's avatar can be enhanced over several gaming sessions. In the real world, games are rarely as durable and persistent, because games typically end when players leave. An exception is Live Action Role Playing (LARP) games which were real world predecessors of MMOG. However, LARP games face a number of limitations that are less present in their computerized successors. For example, such games often need a critical mass of players and that is better reachable online. Preserving the game situation without a computer is challenging, and the number of players can be significantly larger online than in the real world.

Playing a game can be also an emotionally intensive experience. A strong emotional experience is due to deep immersion into the game. This may be caused by various elements of the game itself (such as the game logic, challenge, impressive audiovisual effects), but the player's own imagination and attitude towards the game have important meaning, together with the social aspect. Virtual worlds can be brought to the player's consciousness with rich audiovisual effects. Game events can be enhanced with changes in music type and strength, and colourful visual effects. Multimedia can be used in various ways to enhance the immersion. In real world games, the experience of immersion is often generated by immediate physical participation in game events. For example, in football, the fast paced, keeps the players' concentration on the game.

The four areas of the playing experience highlight the strengths and weaknesses of both traditional real world games and conventional digital games of today. In section 4, we consider the idea of combining these into a new game genre, pervasive games, where both physical reality and sophisticated presentations of virtual game worlds are exploited.

3. Who do we want play with?

We can play games with our friends, pals, family, the neighbourhood, or volleyball crowd. The starting point of games can also be a common interest, such as Star Trek, Buddhism, and bird watching. We can join a on-going game also out of our personal interest. Castells (2005) tells us that a virtual world can be an easy way out of the real world, its problems, tedium, and loneliness. Or simply, we might just be seeking one more forum for activities or a substitute for real world communities. By extending our activities to the net, we are likely to increase the number of weak ties (Granovetter 1973) and thereby be better and more informed of many kinds of things.

Over time, on-line communication can give rise to communities, where groups of people create networks supporting shared interests. Sometimes communication itself can be the shared interest. Roles are played, on-line identities are built, and this leads to formulation of communities that might be short term, but give an alternative way of self-expression and communication. In a virtual world, we may not need to follow the conventions and formalities of real world. For example, in a MMOG community, a player builds a particular game identity over time. This process of building identity is different from that of the real world. Also, "virtual" identities can vary from real world identities. Virtual communities can support formulation of social networks. Network games can support the social aspects in terms of cooperation, or all the game subjects being human controlled. During a long-term participation in a game, it is likely that players will form social ties with meaning beyond the game itself. However, these social networks in a virtual game world do not necessarily overlap with those of the real world.

With the pervasiveness of technology this might change. Advanced mobile devices, embedded technologies, high speed wireless data networks and the interactive media could enable the emergence of new kind of social interaction, where virtual communities and real world social networks meet in an information augmented reality. Information about the game and the players moves between virtuality and reality using mobile media.

4. Where do we play in th future?

As stated earlier, purely new design possibilities within traditional digital games may not be found anymore. Ever increasing computing power and technological advancement enable increasingly impressive multimedia effects and sophisticated ways to transfer virtual reality to our consciousness. New kinds of game designs require new ways of thinking about games, and the situations of playing, and the experience as a whole. A pure pervasive game might be a utopia that will not be realized in near future, but some games already have elements of what are essential for a pervasive gaming experience. In this paper, we use two games as examples: RayGun[1] and Human Pacman (Cheok et al. 2004). We have chosen them because they both take place in real world playgrounds, embedding virtual elements within them. However, these examples have great dissimilarities, including the technology needed by the players. Human PacMan is a game prototype harnessing a range of technologies. Players have custom-made wearable computers with motion sensing technology, GPS, headsets and goggles. The game events are transferred to the game server via a WLAN network that covers the game area, for example downtown Singapore. During game play, while PacMan is moving in the city streets and collecting virtual cookies seen through the goggles, he has to avoid being caught by ghosts. PacMan and the ghosts are human players on the streets. These players can have "helpers" that operate over the Internet. Helpers have an overall view of the

[1] http://www.gizmag.co.uk/go/3539/ and http://www.spectrum.ieee.org/jan06/2569

virtual “PacWorld” and they can, for example, give the players hints about locations of cookies to collect or where to catch PacMan

RayGun is a commercial product that runs on a GPS-equipped mobile phone. The players have a radar-like view on their phones’ displays. The “radar” shows the location of virtual ghosts. Players then try to shoot ghosts by moving in their direction. The faster a player moves, the more powerful the shot. The energy of a shot “annoys” ghosts, and a player can expect more ghosts after shooting one. In RayGun, each player has only limited access to the virtual game world, and the level of immersion in the game depends on the player’s imagination.

Pervasive games are played both in the real world (RW) and the virtual world (VW). From one point of view, the real world is the physical reality we live in. However, shared knowledge of our environment is real, and common for everyone. For example, names of streets in a city or islands in the sea are same for all of us. Each building has its functional meaning that we all share. Laws are same for all of us, even if they change from country to country. Many aspect of people’s shared reality do not leave room to too much interpretation. But many other aspects can be personally interpreted, and this does not make those personal views less real. Our cultural background guides the way we behave in certain situations. Education and experience might help us to see linkage between different phenomena.

A virtual world is a digitally produced, informative layer that is brought to our consciousness through a variety of media, on-line, off-line or broadcast. In this VW, we are often represented by avatars, whose being and doings we can control. In Human PacMan, for example, participants are actually playing the roles of PacMan or a ghost, but simultaneously each player is controlling an avatar that only appears to on-line helpers. On-line media, virtual communities in the Internet, and mobile phones, for example, are providing the opportunity to interact with other avatars, that is, the representations of other game participants. Social communities play an important part in this mediation process. The social skills and networks of the RW can contribute to a player’s personal interpretation of the VW. Players can, as well, have direct personal access to the virtual world, using mobile phones or PCs, to get detailed, perhaps even visual, information. In RayGun, the only direct access to the virtual world is the radar screen showing nearby virtual ghosts. A player can ask his or her friends (playing same game) about ghost sightings or a safe way home. The VW can consist of predefined, static elements, as well as dynamic, context-specific elements. In addition to avatars, independent virtual objects, perhaps equipped with artificial intelligence can live their own lives in the VW, and interact with each other and with avatars.

The virtual layer can be sensitive to undertakings of avatars, and elements can be born, change and disappear. The virtual layer then develops as it is accessed and can portray things that exist in the players’ combined RV+VW reality. In traditional computer and video games, the virtual world is an audiovisually created two-dimensional world, with pervasive games the VW builds on information received via many channels and on players’ own imagination Why not to promote RayGun by organizing ghost seeking campaigns? Advertisements in TV and newspapers could report recent ghost sightings, and make players to more actively take part to the game that never really starts or ends. Players could build up groups and combine their power and knowledge, even if the game logic does not support such activity.

Mobile technology adds the element of movement within these spaces. The information we can get with the WAP services is not much and not very flexible: it is rarely context aware and interaction that it provides is clumsy. However, when we introduce location and movement information into this context, we are closer to the mobile virtual layer actually enhancing the other layers. To start with, information that is prepared for certain purposes about a place can be streamed to the mobile device according to its current location. We can also inquire about the location of another particular mobile device, and at the same time, the

location of the holder of the device. In a game, we could discover the location of the other players, both in the RW and the VW.

Now, where are we as players? Can we be found simply by longitude and latitude (and perhaps altitude) in the RW and the X-Y-Z coordinates of the display in the RW? Art history has taught us (e.g. Saarikangas 1998: 248) that there are as many spaces as there are distinguishable lived spatial experiences. In one physical space, there are always a number of social spaces. How we inhabit space and how we observe it is directed by social and historical contracts and practices. Apparently, we need to study our location and movements in relation to the socio-cultural reality we experience. When playing a game, making sense of where we are located is a multi-layered process.

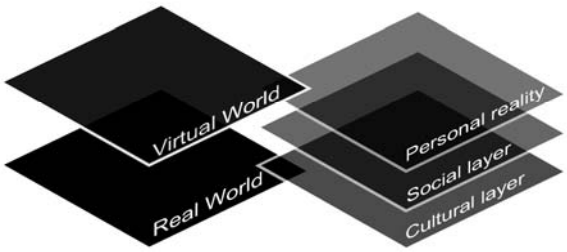

Figure 1: Virtual world is interpreted through our socio-cultural reality that can be seen as layers.

We play in an environment that is both tangible and imagined. We interpret the reality through our socio-cultural history and context and our own personality. In pervasive games we can get away from the screen and the keyboard to the real world of forests and seas, or cities and buildings, but when we add the VW – hopefully with sophisticated interface devices – we can enrich the RW and our personal and socio-cultural experience.

5. Something new

Pervasive games present a new opening for the style of interaction between the RW and the VW. Walther (2005) has defined a pervasive game possibility space as a combination of four pervasive game axes: distribution, mobility, persistence and transmediality. The distribution system includes devices such as computers, mobile phones, networks, sensors, and other equipment. Players, their devices and networks (e.g. Bluetooth) are mobile. Persistence refers to the degree to which the pervasive game is on and available. We can access the game via many media, transmedially.

The game must be aware of the player's location and context. Taking part in the game is not tied to a certain time or place, nor to only one single type of device. This is not the case with Human PacMan, where game area is limited to certain city blocks, and takes place in predefined time. Transmediality and distribution can both be seen as reference to convergence of the different worlds. Interaction between player and computer-maintained game logic could be mediated through a variety of devices in the distribution network, even via broadcast or press media, what best suites the player's current context or the narrative. We need the narrative, the story, to build a game world that is attractive, entertaining and immersive. The story can be very simple, like chasing ghosts in RayGun or eating cookies in the PacMan, and still provide the challenge for the players.

To fully exploit the potential of this pervasiveness, much effort needs to be expended on design, construction and maintaining the game world. A game consists of rules, game entities and game mechanics. These elements exist in or interact with the virtual, physical or social

domains of the game (Magerkurth et al. 2004). When elements of a computer game are alive only in the virtual world and those of a traditional (pre-computer era) game in the physical world, the pervasive game takes elements from both real and virtual worlds, not forgetting the social dimensions of both. Game design needs to consider in which world the different elements are represented. In a pervasive game, entities can be further classified as game objects, human agents and physical objects that are external to pre-defined game rules (Walther 2005). Even with advanced embedded technologies, enabling the interaction between the physical world and the virtual world is problematic. Sensing devices can bring elements such as sound, light and temperature from physical world to computer logic, but it is rather problematic to make sense and use of this data (Magerkurth et al. 2004). On the other hand, to control elements of our physical environment with embedded or other technologies is not feasible in a large scale.

The challenge of covering the possibility space Walther presents is to raise various feasibility issues, not only the above-mentioned problem in interaction between domains. From technological point of view, problems can be expected to exist in integrating different hardware and software platforms and networks to support game play. A game that supports use of broadcast or press media for interaction between players and game world would need a lot of resources allocated to maintain the game. Thus we propose directing the development of first generation pervasive games toward LARP-like games, without the need of deploying technology or other resources that are not already easily available.

GSM, GPRS and 3G mobile networks offer a platform that support global scale communication. The phones we carry every day have advanced features and increasing computing capability. A sufficient level of pervasiveness to meet what Walther and Magerkurth et al. are demanding, could be achieved by building the game world to be available in the Internet, supporting access with a variety of devices (mobile phone, PDA or PC). GPS-positioning would bring direct link from physical domain to virtual domain. Any further contextual information is delivered by users.

In this type of a game, positioning has a central role whereas moving in the game world happens by moving in the real world. Players' locations and their actions can trigger changes in the virtual game world that is also accessible from tabletop PC. The possible game moves are likely to be different depending on the game medium. The enhanced accessibility with more devices than just mobile phone is the element that makes this kind of game a pervasive game rather than just location-based game. In a location based game like RayGun, all the game moves are executed by moving in real world, whereas in a pervasive game such as Human PacMan, we move between virtual worlds, combining and interpreting them in our mind.

6. Something useful, too

We authors, over the years, have felt many pangs of conscience as too much time is spent on games, wasting good effort on something largely unproductive. However, playing in general is necessary part of the experience of meaningful life (Huizinga 1938: 9-38)What if we could combine the fun of game play with something that is actually useful? RayGun and Human PacMan combine exercise and gaming. Exercise is a good thing, and group exercise even a better thing, but their usefulness does not carry much further.

The inputs to pervasive games, we claim, can be data items that are collected for purposes exceeding the borders of game play. For example, why not ask the game participants to allow others to use the information they gather for the common benefit. We already know that in many nature-related events, such as the Backyard Birdwatch (http://www.birdlife.fi/lintuharrastus/pihabongaus-tulokset-2006.shtml), the participants have

willingly and freely shared their observations. A similar campaign has gained huge popularity in UK, where 400 000 reports were posted after the Birdwatch event in 2005 (www.rspb.org.uk/birdwatch). The Finnish Museum of Natural History has on trial an application (www.hatikka.fi) that allows nature observers to keep personal observation logs on their server. If the observer does not deny this, the observations are then included also in the overall database. When we add the dimension of gaming to these popular activities, it is likely that even larger groups of people would participate.

Capra et al (2005) propose combining pervasive games with online and broadcast services to create nationwide campaigns. To turn the birdwatch or coastwatch experience into a game could use a three-level structure of participants: experts, schools & local groups, and the public. The experts who drive the campaign can use broadcast and online media to reach the other groups. Schools and local groups could return their data and feedback to the experts via online services and they could reach the public also during events, visitor centres and the like in addition to online services. The public then could upload large volumes of multimedia information from their personal devices using location-based services.

There are also events where the observers need further tools and guidelines. One of these, Coast Watch 2005, was arranged in October 2005 by the Finnish Association for Nature Conservation[2] . A project that was even more sophisticated, and intended for collecting research data, was carried out by the MIT-based ENVIT (Environmental Information Technology) Group (ENVIT 2006). In this STEFS (Software Tools for Environmental Field Study)[3] project, they intended to create an electronic notebook to collect and analyse field data from environmental and geopositional sensors. A field worker would then get an immediate analysis on the sample entered, supplemented the location information.

STEFS took a step towards using common, widely available, inexpensive devices for specially defined scientific purposes. The project succeeded in integrating mobile mapping (GIS), positioning (GPS) and environmental sensors, but the gathered information remained on the field workers' PDAs until non-automatically transferred to a centralized system for viewing by a group of scientists. This kind of concept combined with possibility to direct transfer of data would increase the efficiency, and release the field worker from the stress of further work with sensor data.

Back to games. Game play is a natural motivator to participate in something that is not immediately necessary or beneficial. Utilizing users to produce information, preferably usable also outside this virtual space, could extend the interaction between users and virtual layer – the game could become even more interesting. A game that coordinates the public to do things with useful side effects would allow gathering large amounts of information from large geographical and social space. By controlling game events and perhaps game logics and rules, the agencies that ultimately use the gathered data, can steer the players to do tasks supporting their needs.

We propose that pervasive games can be used to support research groups who use, for example, environmental data. With appropriate devices and networks, ordinary people could collect field data by means of game play. The game would keep the lay people interested in a continuous effort. This game must be easy to participate in. The devices used should be either very familiar to the players (like their own mobile phones) or easy to manipulate. The game rules should not be overly complex, as the play will take place in a variety of environments. At the same time, however, it is focal that the researchers do get the data they need from where they need it. The amount of data received in this way could be very large. Even though the experts would guide – via the game rules and feedback – the players, there is still a

[2] http://www.sll.fi/toiminta/tapahtumat/2005/rantaseuranta
[3] www.mapxperts.com/gpage.html

likelihood of getting less than optimum quality data. The data would need cleaning, but the replicated data items can help in this.

Another anticipated form of application of pervasive games is education. If the issue to be educated is turned to scenarios, a campaign-like game can be created around the scenario. This kind of approach could enable wider education in terms of participants and the educated issues, and the simulation would be more comprehensive.

To conclude, pervasive games are a novel and complex research area, still waiting for practical applications. The term itself does not yet have a clear definition. It involves many areas of the information technology research of today, including time and space interdependence, environmental adaptability, group and context awareness, and availability of services, to mention a few. Pervasive computing promotes new ways of human-computer interaction, and pervasive games are applications to make use of this. Games could be good application area to pervasive computing, offering not only impending economical value, but also a culturally interesting development trend. To have share in the potential cultural, economical and scientific value of this trend, interdisciplinary research and economical investments have to be made. If services and devices are of good value and easy enough to use for casual users, they can be expected to be quickly adopted throughout the large public.

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