Player Perception of Context Information Utilization in Pervasive Mobile Games

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ABSTRACT
Pervasive games combine real world and virtual game elements in game design. A player might need to find WiFi hot spots, move to different locations based on mobile network cell IDs, or to do certain tasks at different times of the day. These are just few examples how the real world elements can be utilized in game design. The possibilities for using this kind of context information seem versatile, but there is very little knowledge about how players perceive these features. In this paper, we describe a user study where we investigated utilization of multiple context information types in a pervasive mobile game. The results indicate that context information creates a new challenge layer to the game as the players also need to consider issues outside the game world. In addition, the players found context utilization interesting, but it should be carefully explained for what purposes context elements are used in the game design. If the players do not understand the connection between the context and the game design, the feature is not attractive. In our study, time of the day was perceived as the most interesting context information in the game because the utilization was straightforward and easily understood by the players.

Author Keywords
Mobile Game, Pervasive Game, Context Information

INTRODUCTION
Pervasive games introduce a new emerging game genre that pushes the boundaries of traditional games and enables new kinds of gaming experiences for players. One of the most exciting aspects in these games is that they can utilize context information to enrich the gameplay. Moreover, gaming can be blended into daily life and normal social situations of the players.

Pervasive gaming is a wide domain, where real world games are augmented with computing functionality or virtual computer entertainment is augmented with real world elements [14, 16]. Magerkurth et al. [14] and Montola et al. [16] have presented their own categorizations for pervasive games. These two categories differ quite a lot but what is common for both of them, is that they have identified quite many sub-genres for pervasive games, thus emphasizing the wideness of the domain.

Our research focuses on pervasive games that are played with mobile devices. The mobile device is a good platform for pervasive games, since it is with a player all the time. Moreover, it is capable of acquiring information about the current context and it can send information (e.g. location) to a game system, which then defines the appropriate player context.

In our study, we utilize multiple context information sources in an experimental pervasive mobile multiplayer game. This is a distinctive feature compared to many previous game studies, since they have not studied how players experience different context elements. Some of these earlier games (e.g. Treasure [7]; Gopher Game [5]) have used several context elements in their game design, but context information utilization is not studied in detail. Another objective in our study was to explore how the players actually perceive the utilization of different context information. Previous studies (e.g. [18], [7], [4], [2]) have reported that the players have liked context information enhanced games because they can provide engaging and exciting gameplay experiences, but they do not provide very detailed information how the players actually perceived the context information that was used in the design.

RELATED WORK
There are different definitions and many categorizations of context information (e.g. [6], [9], [10], [11]). The term context is versatile and can mean many things. Dey defines

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context as follows [8]: "*Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves*". This indicates that the context affects to interaction between the player and the game. Our view on context information utilization is derived from the definition of pervasive games [15]. Pervasive games break the magic circle of games by incorporating context elements into their gameplay.

The term magic circle was first introduced by Huizinga in 1955 [12] and it has been used in game studies ever since. The magic circle is an invisible area and a mindset where play happens and where play rules apply. Pervasive games try to break this magic circle by incorporating gameplay into everyday life and objects so that a line between the game and the real life is blurred. Next, we present four context categories that have been used in our study: environmental context, spatio-temporal context, proximity context, and social context.

Environment Context

Typical environment context information that could be used by game designers includes temperature, precipitation, cloudiness, and lightness. Some of them have already found their way into commercial games such as *Microsoft Flight Simulator*[1], *Shenmue*[2], and *Boktai: The Sun Is in Your Hand*[3]. The advantages of environment context information are that it is understandable by players because it can be easily observed and measured, or the players can check information from numerous sources. From the game design point of view utilizing environment context is convenient as it is easy to acquire and inexpensive to use. According to Becam and Nenonen [1], there are three ways to use these environmental elements in a game design: linear, non-linear, or as passive decoration. First option is to have linear causality from the real world environment to the game. For example, if it rains in the real world, it rains the in the game world as well. Second option is to have a non-linear causality, which means that there is no clear relationship between the real world and the game world. For example, night time in the real world makes the monsters in the game world more powerful. Third option is to use environmental elements as a passive decoration for the game, and it has no significant effect to the gameplay itself. From the game design point of view the non-linear causality provides the best potential for designers to utilize context information as they like in the design.

[1] http://www.microsoft.com/games/flightsimulatorx/

[2] http://www.shenmue.com/

[3] http://www.konami.jp/gs/game/boktai/english/index.html

Spatio-Temporal Context

Spatio-temporal context information describes the aspects of the player's current context related to the time and location. It can reflect to actual time and location where the player is or it can reflect to relative time and location in the game world. Spatio-temporal context is the most commonly used context information in many previous game studies like in one of the earliest pervasive mobile games, *Botfighters* [3]. The game is based on mobile positioning system and in order to move in the game world, the player has to move in the real world. The game world was also permanent meaning that the player's game character is present in the game world and vulnerable to attacks even if the player is not online.

Another example of using location information in a game is *Gophers* [5]. The game features the use of the player's location, geospatial labeling, media sharing, and automatically creates game event blogs and allows content peer review.

Proximity Context

Proximity context utilizes the existing devices and technologies that are nearby a player and converts them into game elements. Typical infrastructure that is used in pervasive games includes base stations of the mobile network or Wireless LAN hot spots. Proximity context can also include other devices which operate in the network and have different radio transmitters such as Bluetooth or WiMAX enabled.

Several pervasive games have successfully utilized proximity context in their design. For example, in *Feeding Yoshi* the players had to feed the Yoshis (secured WLAN connections) with fruits they had planted into plantations (unsecured WLAN connections) [2]. This study revealed the challenge of combining real world and virtual game elements into an interesting game experience for all players. Those players whose physical location did not contain many WLAN connections, were less successful in the game and reported less enjoyable game experience as the gaming could not be easily blended into their daily activities.

This impact of the real world location to the player's game experience was also reported in *Insectopia* [18], where the players detected Bluetooth IDs, which were then converted to insects by the game system and added to the player's collection. The players considered playing in areas that contained only few Bluetooth IDs was tedious and not always motivating [18].

Social Context

Social context information is related to users and their relationships with other persons. The role of the social context of the players is highly recognized among people working with game design. In addition, non-players might be affected by the game or the game might encourage players to do something ethically unacceptable while playing [17]. Despite of this, social context offers

possibilities to be used more in the gameplay itself. For example, many Facebook games are solely based on user's social context like the application *Friends for Sale*.

Summary

Using context information in games is not a novel idea. There are both experimental and commercial games which utilize context information to enrich the gameplay. When compared to commercial games, experimental games focus on utilizing context information in a more versatile manner, probing new possibilities and the players' attitudes for the use of context information in games. The pervasive games described above usually utilize only one type of context information in their design. Usually players have not previously played pervasive games, which would give them the required experience to compare context information utilization and to recognize if there are any differences in applicability of different types of context information. For this reason it has been impossible to make any conclusion how the players perceived context information utilization in pervasive games. In our study, we provide the results from the experiment where several types of context information are included into one game design and consequently give players the possibility to evaluate and compare how different contexts could be used in a pervasive game.

THE GAME CONCEPT

Mythical the Mobile Awakening is a pervasive mobile multiplayer game which uses context information to enrich the gameplay. The players are wizards and access a magical world that is parallel to our own world, through their mobile phones and battle against AI or human controlled opponents in encounters. The game world is divided into four factions (Dawn, Sun, Dusk, and Moon). Each faction has their own mysteries and skills. The factions have a major role in the game as they are intended to help building a community between players belonging to the same faction and also to make people use different gaming strategies since each faction is unique.

In the magical world the players can develop their magical skills by performing several kinds of rituals. A ritual is a mini game which can be completed successfully when a ritual component is performed in a specific context (Fig. 1A). One of the simplest rituals was to press a button for 10 seconds. The idea with these rituals is not the complexity of the ritual itself, but rather to find the right context when or where to perform it.

Some rituals can include multiple components and each of them might require different context to be performed successfully. Completing a ritual will increase the player's magical skills and reveal local mysteries that are hidden in the magical world. Local folklore and real historical events are used as a basis for some of these mysteries. The player explores these mysteries and reveals new mysteries as the game progresses.

Another important feature is the asynchronous slow-update gameplay, in which the players battle against AI opponents or other players (Fig. 1B). The players can join and leave the encounter as they like, and other players may not even notice if the player is online or offline. The slow-update gameplay is achieved through game event intervals. These intervals can vary from seconds to hours, and they can be either predefined or player-defined. Between the intervals, the players are able to define their next actions which are executed when the interval timer reaches zero.

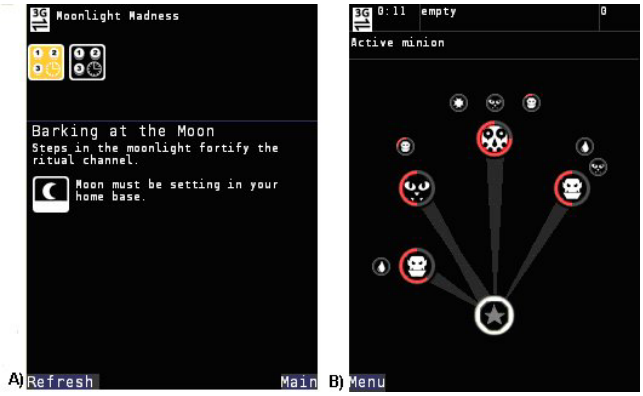

Figure 1: Screenshots from Mythical: the Mobile Awakening. A) Ritual gameplay. B) Encounter gameplay.

The game uses four types of context information: environment, spatio-temporal, proximity, and social. Environmental elements like temperature, cloudiness, and astronomy information were used in the game as they can be acquired from various internet services. Temperature information in the game is simplified and it contains only one break point. Some ritual components should be completed when the temperature is either above or below zero degrees of celcius. Cloudiness is also pretty straightforward information to observe, since in our game system cloudiness has only three values (clear, partly cloudy, and cloudy). Astronomy information is related to the phases of the Moon, and to the positions of the Sun and the Moon related to the horizon.

Spatio-temporal context information was included to the game design as we wanted to utilize local folklore in the rituals and encounters. For this purpose, we defined several locations which are sources for the narratives in the game. Time as context information is very useful context information for different purposes. However, instead of using exact time, we divided a day into four phases (dawn, day, dusk, and night). Players belong to different factions which represent phases of the day. The phases were not equal length and they followed the daylight time at the

player's home base. Dawn and dusk phases lasted approximately one hour each and day and night phases were considerably longer. Due to small shift on periods, we defined 30 minutes buffers to break points to overcome time shift. Time was also considered to be easy attribute to get interesting and sometimes challenging context conditions to perform ritual components.

We also utilized Bluetooth IDs to test proximity context. Some ritual components required that players scan their surroundings and try to find a number of Bluetooth IDs in order to complete a ritual component successfully. Usually this means going to a location which are highly populated.

The final context information in this game is social context. Some rituals require collaboration between players as some ritual components can be completed by a player belonging to a specific faction. Another requirement was that social context involves non-players and their mobile devices to the game design as the players are able to scan possible Bluetooth devices that the non-players are carrying.

USER STUDY

We conducted a user study using both interviews and a questionnaire. In addition, we collected data from the server side to see how players actually played the game.

The game was active 116 days and 373 players played the game during the user study. The server stored information about the play sessions in general, and what rituals and encounters the players played in the game. There were a total of 7156 play sessions and during these sessions the players completed 2595 rituals and 987 encounters. In this paper, we analyze 884 rituals which were context related. In addition, we conducted in-depth interviews and a web questionnaire to complete quantitative data.

The questionnaire was available on the Internet and it was promoted on the game's web site. Fifteen players answered to the questionnaire which included aspects about the gaming experience and especially how the players felt about the use of context information in the game. Unfortunately, the response rate was very low among the players and it is probable that many participants did not visit the web site at all, even though the URL was shown every time the game was launched. It appears that the questionnaire was too separate from the game so probably some of the participants were not even aware of the web site or the questionnaire.

Out of the fifteen players, who answered to the questionnaire, twelve were male and three female. The age varied from 16 to 34, and the average age was 27. Most of the participants had fixed studying/working hours (n=9). Half of the respondents had played mobile games that used context information is some extent.

We recruited six participants to the interview section of the study. The participants were instructed to play the game for one week as much as they wanted to. After that we conducted in-depth interviews that lasted about 1.5 hours each. The participants who were interviewed did not answer to the questionnaire.

Four of the participants were female and two male, and they were between 15 and 16 years. The participants reported that they play videogames approximately 10 to 25 hours per week. None of the participants had previous experience from games that use context information.

RESULTS

In this section we present the main results from the questionnaire, the interviews, and from the event log that are related to the context information and the players' perception about it. The interviewees' comments are coded with an identifier (e.g. U3, means the interviewee number 3).

Korhonen et al. have identified two issues related to context information in pervasive game design [13]. First, the player needs to know what the current context is and whether it is feasible to do certain tasks that require specific conditions to be fulfilled. Second, the player should have an access to relevant context information in the real world. As the designers cannot control how context changes over time, it is possible that for some players certain contexts are never or very seldom met.

Attitude towards Context Information Utilization Was Positive

The players' attitude towards the utilization of the context information was dependent on experience that they had with the game. Based on the interview comments players liked the idea of using context information in the game and how it affected to the gameplay. This brought new gaming experiences to the players that they had not experienced before.

U3: *"Rituals with environment context conditions were interesting."*

U5: *"In my opinion context-aware rituals were really nice."*

U4: *"I think context-aware features would help the player to get involved into the game."*

Similarly, questionnaire results indicated that context information made the game interesting. The questionnaire respondents were clearly positive about using context elements in the game (11 respondents out of 15). However, the attitude towards the context information utilization seemed to correlate with experience players had with the game and not all context information was valued equally. Less experienced players found different context information less interesting in the game. This was possibly because of players had difficulties to imagine what the game experience would be like, if the game requires certain context where it is played.

Spatio-Temporal Context Was Considered the Most Interesting

Utilization of spatio-temporal context got positive feedback from both questionnaire respondents and interviewees and the players found time as the most interesting context information in the game. 60% of the questionnaire respondents found this particular context information exciting. Similarly, interviewees commented spatio-temporal context in a positive manner:

U5: *"I liked those rituals that utilized different times of day the best."*

The game event log supports results from the interviews and the questionnaire. Figure 2 shows how many times each player, who was eligible to play the ritual, played context dependent rituals on average. First six rituals utilized spatio-temporal context information to define when the ritual is performed successfully. Then there are two environment context rituals (R533 and R532) which were played more than once per player. An interesting observation is that the ritual (R534) that required Bluetooth device scanning was played only once on average. Another interesting observation is that rituals which had multiple context conditions were not very popular. The players were not very keen on playing them even though they would have been eligible to perform the ritual.

Context information is not the only determinant when selecting a ritual. Rewards will also motivate the players perform certain rituals. However, the players played more those rituals which had "easier" context requirements to fulfill.

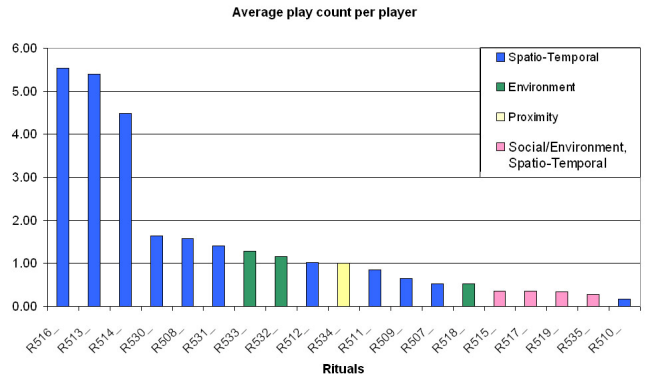

Figure 2: How many times on average a ritual is performed per a player.

The interest of using time of the day as a gameplay element was clearly visible among interviewees and the players even expected that time of the day would have even bigger role in the game.

U2: "*The time factor could be used in the game even more. For example there could be certain types of enemies more at a certain time of a day.*"

Time as a context element was easy to understand and it fitted well with the game theme. There are four factions (Sun, Moon, Dusk, Dawn) that are based on different times of the day. This brings time element naturally to the game and made the players even to expect utilization of time in the game design.

U2: "*At first I thought that the time would affect also to encounters. The members of the School of Sun would be more powerful during the day and so on, but unfortunately it was not like that.*"

This comment also shows that temporal context could have been used more in the game and the players could easily imagine how it would affect the gameplay.

Environment and Proximity Context Information Were Not Seen Interesting

Other context information was not found as interesting as time of the day. The players had difficulties in seeing possibilities that environment or proximity information would bring into the gameplay, if they had not experienced them in the game. Environment context information (temperature, cloudiness, phase of the moon, moon and sun positions) were appreciated only by some intermediate or expert players. Low interest rate among questionnaire respondents can be explained with the fact that in overall approximately half of the intermediate or experts players had completed rituals that included an environment context. Ritual (R518) was very difficult to complete during the study because of the environment context. The ritual required that one component should be done when the temperature is below zero and other one when the temperature is above zero. However, during the wintertime the probability of temperature rising above zero degrees of Celsius is not high in Finland, and therefore, only few players managed to complete the ritual. Moreover, only few expert players had performed Bluetooth related ritual, but we do not know the reason for this low activity. One explanation might be the lack players' experience on using Bluetooth for other tasks on mobile phone. Another explanation could be the fact that the ritual required other people's presence, who has turned on Bluetooth transmitter in their mobile phone, in a close distance.

Context Information Creates a New Challenge Level

Getting the right challenge level in the game is always a tricky part to do and the designers can easily spend hours to balance gameplay and different game elements for optimal gaming experience. In pervasive games utilization of context information adds another challenge layer to the gaming because the players need to find when it is favorable to perform certain actions that will depend on some real world context information and this may not be always easy. In our game user interface it was not indicated

directly whether the context was right or not in any situation; players had to figure it out themselves by using their common sense and interpreting the result of the ritual. This made the game very challenging at some parts.

Another type of challenge comes from the fact that even though conditions would be right, the players may not be able to play the game due to other activities. There might be very practical reasons like school or work that prevent the player from performing the ritual at the right time. One interviewee commented:

U5: *"There are those rituals that are tied to a certain time of the day. So as I belong to the School of Dusk, it is quite short time when the rituals are open and we usually have a class at that time. It is quite hard for me to play then."*

Questionnaire results indicate that performing context-dependent rituals was not a straightforward task (five out of fifteen thought it was hard and four said it was something in between of difficult and easy), but it created a new challenge layer to the game as the players failed in completing simple rituals. Even though the players failed in rituals occasionally, they did not consider it as frustrating or restricting, but rather an interesting and challenging part of the gameplay (Fig. 3). Eight players thought that context information made the game challenging but only three players thought it made the game restricting.

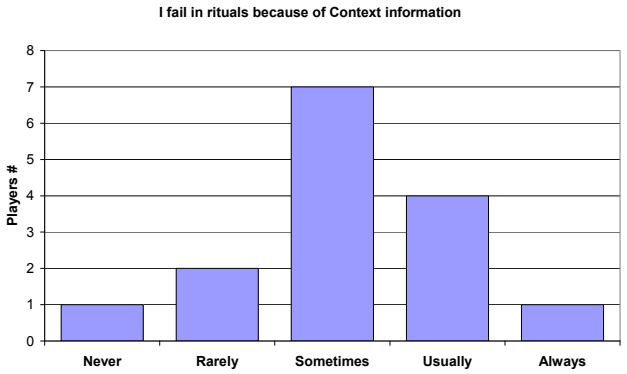

Figure 3: Frequency of failures when performing rituals.

The players unlocked new rituals as they advanced in the game so multiple rituals were usually available for the players to choose from. Usually there were at least some rituals available that could be performed at any given context. This made the game less restricting. Interviewees also agreed that rituals were reasonable although a player cannot necessarily complete the ritual at once.

U3: "*Rituals seem reasonable, especially when you have a multi-component ritual, which can be completed only in certain time during the day.*"

U2: *"I don't think that context-aware rituals would be more challenging. They would be more interesting."*

As the time was used to set conditions when some ritual components could be performed, play sessions were scattered throughout the day and the players completed only few ritual components in one play session. This new gaming mode was accepted by the players and we found positive correlation with statements "*Playing the game on certain time of the day is interesting*" and "*Playing several times during the day makes the game interesting*" ($r = .762$, $p<0.01$). This shows that players accepted and enjoyed the new playing style that this game demands. Also interviewees commented this fragmented play sessions in a positive manner.

U6: *"My game sessions were really fragmented, but I found it interesting that you could continue playing the game at any time or leave it behind."*

Moreover, the players found multiple play sessions throughout the day also as a fun factor in the game. There was a very strong correlation with statements "*Playing the game in certain time of the day is interesting*" and "*Completing a ritual (or part of it) on different time of the day is fun*" ($r = .924$, $p<0.01$).

Still it could be noticed that playing time caused some difficulties for players. As the game was active 24/7 and some rituals required components to be completed at different times of the day, it was presumable that the players would play the game around the clock. Still this was not the case; the game was played the most during the afternoons between 2PM and 4PM (Fig. 4). Another peak was between 5PM and 6PM. These are the times when people usually get out of work or school and have some spare time. Still the game would have required short play sessions throughout the day, which the players may not have been accustomed to. The possibility to blend gaming into other daily activities, even if the game would require only very little attention, seemed to require some adaptation from the players.

U3: *"I liked the idea that you can do things only in certain time. The problem is that you need to basically play the whole day in order to complete the ritual."*

U5: *"There hasn't been a game like that before which is connected to the time of the day and so on. It was totally new."*

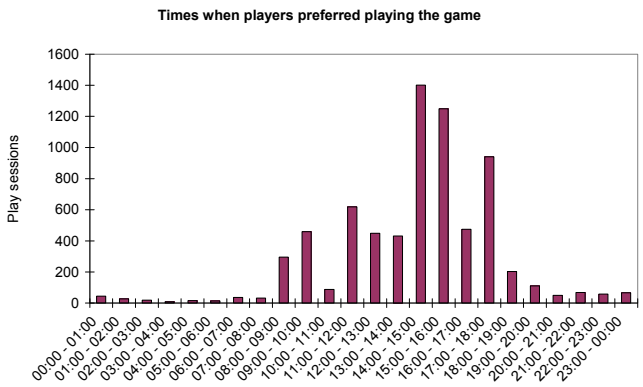

Figure 4: Times when players preferred playing the game.

DISCUSSION

Using context information in mobile games is still in its infancy and, as our study shows, the players can have difficulties in understanding the concept. If the players cannot grasp the purpose of something, they will find it uninteresting. In order to make the use of context information interesting to the players they need to understand the purpose of the context information and also how it is used in the games. Our study, as well as some previous studies [e.g. 2, 3, 18] show that at least spatio-temporal context and proximity context are easy to understand and the players find them interesting and compelling. Especially utilization of proximity context has proven to be fun for the players and they have even started changing their daily routines when playing these games [2, 3]. Therefore, it is interesting that in our study proximity context was not considered very interesting. One explanation could be that there were not many players, who had the possibility to perform rituals which utilized proximity context. Another reason might be that the proximity context, unlike in some other games, was not the only context information type in the game and as there were multiple rituals to choose from. The players might have picked other rituals which suited their current situation better instead of playing rituals including proximity context. Location information can also provide compelling gaming experiences like Botfighters [3], and Treasure [7] have shown. Our study supports this conclusion and the players considered playing games at different times of the day to be engaging. Other context information has not been used that much in games and they may be harder for the players to understand. In our study after the players understood the purpose of the context information such as time of the day, they thought that it was an interesting game feature that provided a new and meaningful challenge layer.

The main issues in designing games that use context information is to make sure that the players are able to intuitively understand the specific contexts in the game; how they change, and how they are used as game elements. For example, the time of the day is intuitive to understand and it is easy to see how the context changes. In our game, some rituals were thematically connected to the required time of the day. As an example, the ritual to invoke Moon Faeries had to be completed during night. Context information which has no concrete or visible counterpart in the reality is especially difficult for players to understand. Context such as overall network traffic in a WiFi hotspot is impossible to perceive without special equipment. Regular players might have difficulties in understanding how it is relevant for the game and thus regard it only as a random game element.

Even when the players are able to understand how the context is used in the game, the characteristics might make it difficult or even prohibitive for the players to play the game accordingly. Bell et al. [2] reported that in the game using WiFi some of the players commented that getting a good position and signal strength for certain game elements would require entering unsafe or even dangerous places. In our game, some rituals could require playing the game very late in the night and during summer time this would mean that the players are expected to play the game after midnight. These kinds of features are interesting for some players, but certainly not for the majority. The designers have to carefully think how disruptive behavior their game is going to require from the players. Montola et al. [17] discuss issues such as possible ridicule and awkwardness in playing the games in public spaces and Bell et al. [2] report similar concerns about drawing unnecessary attention to the players. In our study, the interviewed players or questionnaire respondents did not report any of these kinds of problems while they were playing the game, but it might be that they did not fall into such situations.

Designing pervasive games that use context information is a challenging task but according to our study they might have commercially potential. More studies should be made to explore this potential further. The developers of future pervasive mobile games with context information should be careful and bold at the same time: bold to explore different kinds of contexts and interaction models but careful to evaluate the design with real players. The same developers also carry the burden of responsibility. The first commercial products, if badly designed, might ruin the reputation for pervasive mobile games for years.

CONCLUSIONS

In this paper we have studied context information utilization in a pervasive multiplayer mobile game. For that purpose we implemented an experimental mobile game which uses several types of context information in the game design. We used environment context information such as temperature, cloudiness, and astronomy information as they are easily acquired from various internet services. Modified versions of the current time and location were selected from

spatio-temporal context category. From proximity context category we selected Bluetooth devices that represent technologies and devices nearby the player. Finally some social context issues were included to the design as the game required collaboration with players belonging to different factions or non-players. In order to study how the players perceived different context information, we arranged a user study. The results indicate that the players found the game enhanced with context information interesting. However, interest towards the specific context information is really much dependent on the player's experience with the game. If the player has not encountered the specific context information in the game, it is hardly interesting. In our study, the players found time as the most interesting context information. In addition, utilization of the context information creates a new challenge layer to the game as they need to find out right context to complete different tasks. Nevertheless, the players found this feature engaging and fun. This study was a first attempt to explore how the players perceive different context information utilization in the pervasive mobile game.

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