

Designing for Physical Interaction and Contingent Encounters in a Mobile Gaming Situation

Liselott Brunnberg
Mobility Studio, The Interactive Institute
P.O. Box 24082
104 50 Stockholm, Sweden
+46 70 320 68 06
liselott@tii.se

Kristina Hultström
Mobility Studio, The Interactive Institute
P.O. Box 24082
104 50 Stockholm, Sweden
+46 70 845 15 94
kristina.hulterstrom@tii.se

ABSTRACT

Backseat Gaming is a project set out to investigate how the highway experience can be used as resource in a mobile augmented reality game. At the same time as it opens new possibilities for novel and engaging mobile experiences it also introduce many design challenges. In this paper, we present challenges and implications on the design of two different games, when using the vivid and dynamic mobile context as resource. Essential issues concerns how to adapt the game to the temporality and unpredictability of different mobile situations, safety and the way the interaction is designed and implemented in order to benefit from the dynamic and vivid mobile context.

Keywords

Mobile game, augmented reality, social interaction, tangible interaction, physical user interfaces.

1. INTRODUCTION

Backseat Gaming is a project set out to investigate how the highway experience, created during car travel, can be used as resource in a mobile augmented reality game. Despite changed circumstances when being mobile there are only a few examples of games that exploit the benefits of incorporating different aspects of mobility within the experience [e.g. 3, 6, 9]. We believe that a mobile game can become compelling, in a new way, if it is aware of the vivid and dynamic mobile context. Car travelling is a good example, where changing scenes, sense of motion and contingent encounters provide for a special experience in a true mobile situation.

The first prototype developed within the Backseat Gaming project made use of the changing scenery and sense of motion created during car travel as a resource in the game. We were concerned with the fictitious connection between the game and the surrounding world and how this spatial relation was *interpreted*, *explored* and *manipulated* during the game play. User feedback showed positive reactions both towards the idea of using road objects and car travel as gaming resources as well as the idea of the roadside as a fascinating game world to explore. We

concluded that the game concept was a plausible design approach worth investigating further. The second prototype, which is based on the preceding version, benefit from contingent encounters with other players by using them as a resource in the game. Contingent encounters are central in the highway experience [1]. By creating an ad hoc peer-to-peer multiplayer game we explore how contingent encounters and the motion of the accompanying traffic can be used in an engaging mobile gaming experience.

Using the highway experience as resource in a mobile game raises several design challenges both regarding game design and the interaction. A central design challenge concerning the first prototype was to understand the characteristics of the linkage between roadside objects and the game, in order to create a satisfactory user experience. It was essential that users were able to interpret the objects correctly, enjoyed the exploration of the game space, and could manipulate the relationship in an engaging manner. The temporality and unpredictability of contingent encounters on the road call for new design challenges. Due to high relative speed, people meet for very short period of time. Still, some other encounters persist. The nature of contingent encounters inspired us to explore an alternative interface and ability to interact in order to benefit from the highway experience in the game-play. Important design criteria for the interaction concern the fictitious connection between game and the surrounding physical world, contextual situations of the game event, social interaction, awareness and body constraints. An additional design challenge concern safety, it is essential that the game-play doesn't affect the driving of the vehicle.

This paper focuses on design challenges and implications when using real world context, i.e. the highway experience, as game resource in a true mobile situation. We will shortly present the implementation and findings from the first prototype. We will then discuss design challenges and implications when integrating contingent encounters as resource in the game. We believe that these findings also could apply to other mobile situations and be useful for the design of future context aware mobile experiences.

2. THE FIRST PROTOTYPE

The first prototype [3] realise a game consisting of a framing story and physical game locations where local stories are told and game manipulation is pursued. The framing story is told when the game starts to provide the player with an understanding of the rules and goals of the game. When the car approaches a game location an animated local story is triggered. The player has to attend the story in order to find virtual objects at the locations. A manipulative event is triggered when the player comes even

closer to the location. The device automatically changes to a small and virtual window. The player can now aim at objects in the physical environment, which have been described in the local story, to find virtual objects and to make them appear on the screen. By pressing a button on the device, the player can now attack or pick up the object. The game is implemented on a Pocket PC. The device is aware of its geographical position by means of a GPS-receiver and its aiming direction by means of a digital compass mounted on the backside of the Pocket PC.



Figure 1: Hardware Figure 2: Gaming device

2.1 Summary of user feedback

A test was carried out in order to acquire feedback on how players enjoyed, understood and handled the game. The study of the test provided knowledge about individual gaming situations although the number of test situations was limited and an indication of user experience of mobile context-dependent gaming in a road setting. The test showed positive reactions both towards the idea of using road objects and car travel as gaming resources as well as the idea of the roadside as a fascinating game world to explore. It was possible for the children to understand the game concept, interpret the objects as well as technically manipulate the fictitious relation successfully.



Figure 3: Kids playing Backseat Gaming

The players adopted different gaming strategies depending on the nature of the objects involved. There was a noticeable difference between the ways they moved the device, and how they fixed their gaze, during different types of manipulative events. When a singular virtual object was placed in close proximity of a specific physical object, e.g. a virtual document dropped at an old oak tree, the players gaze moved back and forth between the screen and the physical object to make sure that they aimed in the right direction. If the game event consisted of several virtual objects spread over a larger physical space such as an allotment area inhabited by several virtual creatures, the exploration was cumbersome. They focused either on the screen waiting for objects to show up or out through the window, peppering the environment, without checking whether there were any virtual objects on the screen. The complex and vivid mobile context bring about a need for different gaming strategies. We conclude that the intention of

establishing an engaging fictitious connection between the game and the surrounding physical roadside was successful even with a light-version of augmented reality technology, but the test also indicate that the game could benefit from more non-visual feedback in order to even further augment the fictitious connection to the real world and to facilitate for the player to cope with different contextual situations.

3. THE SECOND PROTOTYPE

3.1 Design Challenges

The second prototype makes in addition to the roadside also use of contingent encounters as a resource in the game. The intention is to investigate how contingent encounter can add to the gaming experience in a true mobile situation. Contingent encounters such as rapid meetings, protracted overtaking or gatherings i.e. traffic jams or red light accumulations constitute an essential part of the travel experience. The design challenge when using traffic encounters as a resource in the game lie in their temporal and unpredictable nature. Encounters can occur anywhere and anytime during the journey, still encounters essential for the game i.e. other players, might not occur during long periods of time or not at all. Due to high relative speed, people meet for very short period of time. Still, some other encounters persists, two vehicles might for example end up in a caravan driving towards the same direction for a longer period of time [5]. It is difficult to predict when an encounter will occur and end. Integrating encounters as a resource in a mobile game involves a game design that take in to account sudden appearance of potential players, momentary respective continuous encounters as well as sudden and unexpected interruptions between players. It is also essential that the game-play won't affect the driving of the vehicle. Safety is an important issue when designing applications for use in the car. It is easy to imagine a situation where the player tries to affect the driver to change the driving of the vehicle in order to profit the game play.

Crucial for the success of the game is the design of the interface and the ability to interact during game-play. Firstly, it needs to be designed to support the concept of using the travel experience as resource in the game. Secondly, it needs to be adapted to the context of traveling in a car. To design an interface that supports the concept of using the travel experience as resource in the game motivates several design criteria. As indicated in the tests of the first prototype, the interaction during the game-play need to support different game situations and strategies adapted to the physical context. It also inspired experiments with more non-visual feedback in order to further augment the fictional connection between the game and the surrounding road context. To encourage and facilitate for the user to focus on what is happening outside the car rather than on a screen during game events is even more essential when making use of contingent encounters in the game. This is due to our motivation to spur social interaction and awareness of other players during encounters, which can happen suddenly, during swift periods of time. At the same time it is also important to cultivate the fantasy and imagination of the game and to provide the player with proper feedback and understanding of the game-play. Additionally, the ability to interact needs to be designed with the context of traveling in a car in mind. This concern the players constrained position in the car and different safety issues. However, this will

not be discussed here as this paper focus is on the use of the real world as resource within the game.

3.2 The Game

The game consists as the first prototype of a framing story and physical game locations where local stories are told and game manipulation is pursued. The game also consists of multiplayer events automatically taking place when the players are in the proximity of each other. Physical game locations involve the player in the game play when no other players are in the proximity. The framing story is told when the game starts to provide the player with an understanding of the rules and goals of the game. The player's goal is to gain as high power, counted in power-points, as possible before getting to the big yearly meeting for witches and warlocks. High power can be gained both by achieving knowledge, such as new spells, gather powerful objects or by being the most powerful in battles. High power will gain the witch or warlock high status at the meeting. In the beginning of the game the player takes on the role of a witch or a warlock possessing different magical specialities. The character always carries a sack to collect objects in. Different objects can be used to help the character to gain power. The objects can be picked up from the roadside respective stolen or exchanged with other players during multiplayer events.

The game is implemented on the same technical platform as the first prototype but with a few changes. Gaming activity between players during multiplayer events is accomplished through peer-to-peer wireless ad hoc networking. The application uses a rapid mutual peer discovery protocol in order to quickly detect and connect the players when they meet [5]. An external button is also integrated in order to accomplish a squeezable interface and an intuitive interaction during brief encounters.

3.3 Design Implications for Contingent Encounters

When players come within proximity of each other, approximately within 150 meter, a multiplayer event will be triggered. The game is currently limited to take place only between two players. It is designed in such way that a multiplayer session can be played regardless of the duration of the encounter. An encounter will result in a battle between the players in the purpose of enchanting the others character and thereby capture some of the other characters skills or power. If a battle is ended earlier, because of disconnection, the character with most hits will simply be rewarded with power-points. When one character have become enchanted the battle will end, the players can now involve themselves in exchanging objects with each other or fight for objects found on the roadside. By gaining the right objects a character can break its spell. The rules of the game is designed in such way that a player will not lose or win anything by the actual disconnection from the other player, this with the intention of not affecting the driving of the vehicle with the game-play. A player should for example not have any advantage for intentionally breaking the connection with another player trying to escape from an enchantment neither should there be any disadvantage if one vehicles happen to drive in different directions in a crossing.

3.4 Design Implications for Interaction

Our main purpose when designing the interface and the ability to interact within the game was the intention to support the concept

of using the travel experience as resource. With this in mind, we set out the following prerequisites for the design:

- The user interface should be designed to support the fictitious connection between the game and the physical world and on the same time cultivate the player's fantasy and imagination.
- It should take different contextual situations in to account, it should support both interaction with the roadside as well as interaction with other player during momentary respective continuous encounters.
- It should support awareness and social interaction between players.
- It should relate to the theme of the game.

The intention to preserve the connection with the physical world was of specific relevance when designing the interaction for the multiplayer events, as contingent meetings can be very brief and we wanted to encourage social interaction between the players. We believe that seeing the other player during interaction will increase the gaming experience and spur social interaction. We believe that split attention between the screen and the outside world, which was the result of the graphical interface used in the previous prototype, would limit the social interaction possibilities of the game, especially during brief encounters. Thus, to encourage the user to focus directly on what is happening outside the car rather than on the screen during interaction, the current prototype has a tangible interface. The tangible interface is realized by detaching the digital compass from its previous mounted location on the back of the Pocket PC. The compass is instead used as a separate item connected through a longer cable to the Pocket PC. The digital compass is in this way turned in to a sort of magic tool. The design of the detached interface is intended to spur the users to interact socially by gestures during the longer meetings. In swift meetings, when the period of time for interaction with other players is limited, the player could concentrate on spotting the other player and act instantly without looking at the display.

To further encourage the player to interact directly with the physical world, we have used sound rather than graphics as feedback on the interaction. Sound indicates the direction to game related objects. We have also used sound as a two-sided feedback, meaning that both players taking part in a multiplayer event will hear a sound as a result of an action. The feedback was designed with the purpose of increasing the awareness and feeling of presence of the other player and to encourage social interaction. Sound is also used to make the players aware of an approaching player. As two cars come within proximity of each other, the players will hear sound as an indication of the other player's presence. To further support awareness it is possible to imagine a small light on the roof of the cars etc. to help the players to immediately spot their competitor. To instantly be aware of the other players presence is of special importance during brief meetings that are too short to be spent searching for the right car.

We have implemented the interaction as a choice of different weapons. To follow up on the theme of the game, the tangible interface can be used as a magical wand, a magical hoover and a squeezer. Three basic features intended for use in different kind of situations distinguish the weapons. The wand can be used to cast magic spells on other players. To cast a spell, the magic wand

should be swung to follow a particular pattern. This is a rather slow procedure suitable for encounters that lasts for a longer period of time, such as when two vehicles end up in a caravan driving towards the same direction. Casting a spell is not easy, but those who learn to master the magic wand will be very powerful. The wand is also intended to incite social interaction by gestures. To pick up objects along the road, the best choice of weapon will be the magical hoover. The hoover can also be used to exchange things with other players and to place things along the road. It is easy to use and can be used in almost any kind of traffic encounter. The squeezer is preferable for very brief meetings when the interaction time is limited. To fire the squeezer, the interface should be squeezed. To squeeze the interface is easier and much less time consuming than moving the interface to follow some predefined pattern. Consequently, the squeezer is suitable for encounters that last for a very short period of time, possibly less than a second. In order to cultivate the fantasy and imagination of the game and at the same time preserve the connection with the real world we have chosen to use the screen as interface in between different gaming events. Additionally, there must be a clear connection between the screen interface and the use of the tangible interface. We have used screen based graphics to show the local stories before physical game locations and to reveal the other character in multiplayer events. Graphical feedback showing the result of the interaction and other information, such as objects in possession of the player, is visible on the screen after the interactive events.

4. RELATED WORK

A number of research projects explore aspects of integrating tangible, social and human to physical world interaction into digital and ubiquitous games. Examples include Touch-space [4] and Pirates! [2] Touch-space is a system which constitutes a game space where physical and social aspect of traditional game play is integrated with fantasy features of traditional computer entertainment. Pirates! is a wireless multi-player game also exploring novel ways to maintain social aspects of traditional game play in a computer game. Pirates! take place within physical space and uses proximity to locations or other players to activate events in the game. However, common among these projects are that they explore interaction between human to human and human to physical world within a very enclosed space as that of a room relying on pre-set infrastructures. Exploring the possibilities of using travel experience as a resource in a gaming situation constitutes a different design challenge than the ones in a pre-set room.

Games exploiting issues of incorporating different aspects of mobility and the physicality within the experience in an outdoor setting include Can you see me now? and Bystander [6], both part of the Citywide project [8]. These two games explore collaboration between online participants and mobile participants on the street. Commercially available Botfighters [9] from It's Alive use location and proximity of players as a resource in the game. The location is determined with GSM mobile phone positioning, which is too inaccurate for the purpose of our research. Additionally, our design is inspired by research on tangible and graspable interfaces, as for example work made by Ishii and Ullmer [7].

5. CONCLUSION

We have presented design challenges and implications considered when using the highway experience as resource in a game. Using the real world context as resource in a mobile game includes a wide variety of design challenges concerning how to adapt the game design to the temporality and unpredictability of different mobile situations, safety and the way the interaction is designed and implemented in order to benefit from the dynamic and vivid mobile context. When designing the interaction we have carefully considered issues such as how to support the fictitious connection between the game and the real world and simultaneously cultivate the player's fantasy and imagination, and how to support social interaction and awareness between players. We have used a tangible interface that directly links the digital world and the physical world and provides a seamless method of allowing natural physical and social interaction between people [4]. Traveling in a car constitute a true mobile situation, by studying the highway experience as resource highlight several design issues regarding the benefits and challenges of incorporating different aspects of mobility within a digital experience. We believe that the conclusions made within this setting could apply to other mobile situations and be useful for the design of future context aware mobile experiences.

6. ACKNOWLEDGMENTS

We thank SITI for partially funding the research in the project. We would also like to thank members of the Mobility studio for ideas, aid and valuable comments.

7. REFERENCES

- [1] Appleyard, D., Lynch, K. et al (1964), *The View from the Road*, MIT press.
- [2] Björk, S. et al. Pirates! Using the Physical World as a Game Board. *Interact*, 2001,
- [3] Brunnberg, L., and Juhlin, O. Motion and Spatiality in a Gaming Situation – Enhancing Mobile Computer Games with the Highway Experience. *Interact*, 2003.
- [4] Cheok, A.D. et al. Touch-Space: Mixed Reality Game Space Based on Ubiquitous, Tangible, and Social Computing. *Personal and Ubiquitous Computing*, 2002.
- [5] Esbjörnsson, M. et al. Adding Value to Traffic Encounters: A Design Rationale for Mobile Ad Hoc Computing Services. In *Proceedings of IRIS'26*, Helsinki, 2003.
- [6] Flintham, M. et al. Where On-line meets on-the-streets: experiences with mobile mixed reality games. *Human Factors in Computing Systems, CHI'03*, 2003.
- [7] Ishii H, Ullmer B. Tangible bits: towards seamless interfaces between people, bits and atoms. *Human Factors in Computing Systems, CHI'97*, 1997.
- [8] Izadi, S. et al. Citywide: supporting interactive digital experiences across physical space. *Personal and Ubiquitous Computing*, 2002.
- [9] www.itsalive.com – verified 8th June 2003.