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

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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. 

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 lye 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
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

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
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
not be discussed here as this paper focus is on the use of the real
world as resource within the game.
should be swung to follow a particular pattern. This is a rather slow procedure suitable for encounters that last 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 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.

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7. REFERENCES