neXus - designing a dedicated mediascape device

Pieter Diepenmaat, Erik Geelhoed
Mobile and Media Systems Laboratory
HP Laboratories Bristol
HPL-2006-178
December 13, 2006*

mediascape, experience, location aware computing, 3D audio, gesture interaction, tactile feedback, interaction design, location based game

Hewlett Packard Laboratories is currently working on a new generation of mobile, context sensitive and networked devices that offer novel experiences to users by linking the physical and the virtual world. This type of experience is called a mediascape and can be defined as:

'A mediascape is a mixed reality experience in which the 'visitor' is presented with digital media (such as text, images, sound, and/or video) depending on their travels through the physical world.'

First examples of mediascapes, like museum tours and virtual graffiti, make use of existing devices, i.e. conventional platforms on which the mediascape experience is designed. This project concentrates on the design of a dedicated device. There is a wide variety of mediascapes and the number of mediascapes is still increasing. In this project the mediascapes are grouped in a number of genres and analysed. It is undesirable to develop a device that tries to suit the whole range of possible mediascape experiences. Therefore the project concentrates on the development of a dedicated device particularly suited for Location Based Games (LBGs). LBGs, and more specific running LBGs, offer a unique opportunity to explore the possibilities of Location aware computing, because of its highly interactive and dynamic nature. The user of a LBG interacts with the device to manipulate virtual elements and the game play evokes action and reaction. Also, the rigorous use of the device in the case of running LBGs is an opportunity to demonstrate the value of dedicated location aware devices. By optimizing the device for making game decisions while running (dynamic mobility), it will move away from static mobility gaming experiences and facilitate a gaming experience closer to playground games and sports. Two game concepts, 'Run anywhere' and 'Captivate the Crowd', were developed during the project and formed the foundation for the development of the dedicated device. These game concepts (and other ideas) led to a list of actions generic to running LBGs, and led to the decision to use arm/hand gestures to manipulate the virtual world. Arm/hand gestures make the interaction visible to other players, which enables them to react. Making manipulations of the virtual world visible in the physical world also evokes the merging of these two worlds, yielding so-called Magic Moments. The actions generic to running LBGs were translated into a design and interaction for the device, i.e. guiding and sensing these gestures and providing the player with feedback. The developed 'neXus' duo-device consists of a hand controller and a pair of headphones. The hand controller enables the player to manipulate virtual elements (objects, areas, characters and avatars) and gives tactile feedback. The headphones provide the player with 3D audio, used to guide the player through the virtual world and to give feedback as well. The neXus evokes the merging of the virtual and the physical world, provides for a pleasurable mediascape experiences, and demonstrates the potential of dedicated device design for Location Aware Computing.

* Internal Accession Date Only
Approved for External Publication

nexus hp

pieter diepermaat

designing a dedicated mediascape device

master thesis project in Industrial Design Engineering at the Technical University Delft, HP-Labs Bristol

Pieter Diepenmaat
neXus - designing a dedicated mediascape device.
master thesis project in Industrial Design Engineering
for videos and further information, please visit www.pieterdiepenmaat.nl/neXus

April 2006

Delft University of Technology
Faculty of Industrial Design Engineering

Hewlett-Packard Laboratories Bristol, UK
Mobile and Media Systems lab

Committee:
Prof. dr. Pieter Jan Stappers, Department of Industrial Design (Chairman)
Dr. Gert Pasman, Department of Industrial Design
Drs. Erik Geelhoed, HP Labs, Mobile and Media Systems lab (Company Mentor)

Thank you to,

Erik Geelhoed for giving me this opportunity, your feedback and making me immediately feel welcome in Bristol.
Everyone at the Mobile Bristol team for the nice time and inpsiring workplace on and of the pitch.

Pieter Jan Stappers fort inspiring me to explore.
Gert Pasman for providing the right feedback when I needed it.

Everyone who helped me make the movie, especially Fay and Anuska.
Everyone who helped & took part in the workshop, expecially Sietske.
Everyone who took part in the brainstorm session.

My house mates on Ashley Hill

Zo architecten for profiding the perfect workshop and movie location.

Maurits, for being on the cover
Aernout for modeling and rendering my final design
Johan for not modeling and rendering my final design, but thinking up game concepts.
Wouter for everything!

Everyone at the id-studiolab.
the maMasBoys

and to all my friends and family for their support.

Contents

Abstract

Hewlett Packard Laboratories is currently working on a new generation of mobile, context sensitive and networked devices that offer novel experiences to users by linking the physical and the virtual world. This type of experience is called a mediascape and can be defined as:

'A mediascape is a mixed reality experience in which the 'visitor' is presented with digital media (such as text, images, sound, and/or video) depending on their travels through the physical world.'

First examples of mediascapes, like museum tours and virtual graffiti, make use of existing devices, i.e. conventional platforms on which the mediascape experience is designed. This project concentrates on the design of a dedicated device. There is a wide variety of mediascapes and the number of mediascapes is still increasing. In this project the mediascapes are grouped in a number of genres and analysed.

It is undesirable to develop a device that tries to suit the whole range of possible mediascape experiences. Therefore the project concentrates on the development of a dedicated device particularly suited for Location Based Games (LBGs). LBGs, and more specific running LBGs, offer a unique opportunity to explore the possibilities of Location aware computing, because of its highly interactive and dynamic nature. The user of a LBG interacts with the device to manipulate virtual elements and the game play evokes action and reaction. Also, the rigorous use of the device in the case of running LBGs is an opportunity to demonstrate the value of dedicated location aware devices.

By optimizing the device for making game decisions while running (dynamic mobility), it will move away from static mobility gaming experiences and facilitate a gaming experience closer to playground games and sports. Two game concepts, 'Run anywhere' and 'Captivate the Crowd', were developed during the project and formed the foundation for the development of the dedicated device. These game concepts (and other ideas) led to a list of actions generic to running LBGs, and led to the decision to use arm/hand gestures to manipulate the virtual world. Arm/hand gestures make the interaction visible to other players, which enables them to react. Making manipulations of the virtual world visible in the physical world also evokes the merging of these two worlds, yielding so-called Magic Moments. The actions generic to running LBGs were translated into a design and interaction for the device, i.e. guiding and sensing these gestures and providing the player with feedback.

The developed 'neXus' duo-device consists of a hand controller and a pair of headphones. The hand controller enables the player to manipulate virtual elements (objects, areas, characters and avatars) and gives tactile feedback. The headphones provide the player with 3D audio, used to guide the player through the virtual world and to give feedback as well. The neXus evokes the merging of the virtual and the physical world, provides for a pleasurable mediascape experiences, and demonstrates the potential of dedicated device design for Location Aware Computing.

1. introduction

Technologies that enable ubiquitous computing have matured to the point where real-world applications are beginning to emerge. These developments are important for companies such as Hewlett Packard (HP) in offering opportunities for new products and services. Hewlett Packard Laboratories (HP Labs) in Bristol, UK, focuses on one of these developments: a new generation of mobile, context sensitive and networked devices that offer novel experiences to users by linking the physical and the virtual world. The first examples of these experiences, also called "mediascapes", can be found in applications such as museum tours and virtual graffiti. Mediascapes are also developed in research projects such as Mobile Bristol, as initiated by HP Labs.

'A mediascape is a mixed reality experience in which the 'visitor' is presented with digital media (such as text, images, sound, and/or video) depending on their travels through the physical world.'

By their definition, mediascapes are used solely for entertainment purposes. But these first examples make use of existing devices, i.e. conventional platforms on which the mediascape experience is designed. The design of a dedicated device itself, which surely is an integral and important part of this experience, has not been addressed systematically in a focused research and design effort. That's what this project is about.

invent

1.1 Hewlett Packard Labs Bristol

Hewlett Packard serves both individual consumers as well as small and large businesses with printing, scanning, monitoring, computers and computer peripheral hardware solutions. The majority of HP's research is conducted in the various business groups. These R&D groups develop the products and services that HP offers to their customers.

HP Labs on the other hand, located in six locations around the world, delivers breakthrough technologies and technology advancements that will provide for a competitive advantage for HP. The aim is to create business opportunities that go beyond HP's current strategies.

Mobile and Media Systems lab

Part of HP labs in Bristol is the Mobile and Media Systems lab. Within this department several design- and research-programs are carried out, among which the Technology and Lifestyle Integration Program. The program's objective is to develop technology and lifestyle insights that will lead to valuable and profitable integration of mobile and media technology into the daily lives of consumers and businesses. Technologies will only be successful when they are an integral part of people's lives.

User research within the research program is pursued with three foci: device and solution usage, solution experience design and lifestyle research. The solution focus of the group is the delivery of rich media through pervasive and context-aware technologies. An important vehicle in the research is the infrastructure provided by the Mobile Bristol projects. Mobile Bristol is a "citywide laboratory" developed by the T&LI group, Bristol University and The Appliance Studio, funded in part by the UK's Department of Trade and Industry.

1.2 Mobile Bristol

The Mobile Bristol project envisions a future of mobile digital entertainment in which a digital landscape overlays the physical world.

'As you walk through the city a diverse range of digital media experiences such as soundscapes, games, interactive media and art bring the city alive and augment the ambience of the physical places.'

In the scope of the Mobile Bristol Project, a test-bed has been set up in the city of Bristol to learn about the user responses to these digital media experiences.

'The vision of the test-bed is to provide a digital canvas over the city onto which rich digital experiences can be painted and new commercial ventures can be explored.'

In the three years that Mobile Bristol is currently running a technical infrastructure was implemented, a mediascape toolkit was developed, and mediascapes were designed and tested. The Mobile Bristol project has provided valuable insights into what makes mediascape experiences pleasurable to people and what is needed to create these experiences from a technological and developmental perspective. These insights serve as the starting point for this graduation project, and will be described briefly in chapters 1 and 2.

1.3 location aware computing

The core of a mediascape experience is the technical capability of a mobile computing device to sense its location. When this geographical information is used in a way that is relevant to the user this is known as Location Aware Computing (LAC)[1]. Depending how the device uses the location information, LAC applications (products and services) can be divided into three categories: enhancing existing applications, dedicated utilitarian LAC applications and dedicated entertainment LAC applications.

Only one of these categories, dedicated entertainment LAC applications, refers to mediascapes and the products that facilitate them. The other categories of LAC applications provide valuable lessons for the design of mediascape applications.

enhance existing applications

Existing applications can be enhanced by making them aware of their location. For example, this is done in the human computer interaction (HCI) research and design field of context sensitive computing. Context sensitive computing aims to use its key technological enablers – small sensors and intelligence - to be more sensitive to the changing user needs whenever the context of use changes. For instance, if your laptop would sense you are running a presentation, it could adjust the sound settings and your availability for online communication. Whereas when you are sitting at your desk, it would alert you when an e-mail arrives and show your contacts you are available for online communication. By sensing the context of use, and interpreting it, applications will adapt to the changing user needs more efficiently. Location is one of the many important components for an efficient sensing of the context of use.

Theoretically it sounds like this would lead to more user-friendly products, but implementation raises practical problems and touches upon fundamental issues. How would a device sense the context of use? Your laptop might know you are at work. It might even know you are in a meeting room with other people and running PowerPoint. But does this mean you are in a professional meeting? And what if you're in an informal meeting? Does this imply you don't want to be notified of an important e-mail you have been waiting for all day? These problems boil down to two fundamentally different philosophical views on 'what is context' (Dourish, 2004[2]), which are both relevant to design.

The two different views share the distinction between 'the content', often the product or the user-product interaction, and 'the context' around that content. But the way they look at content and context and the relations between them differ dramatically. The positivist viewpoint, used in the engineering and technological world, sees the context as the world around the product: location, number of people in the room, programs running on computer. This world exists independent from the content. The phenomenological view, used in social science, sees content and context as mutually defining and dependent. What matters around the

1 Dey, A. K., Abowd, G. D., & Salber, D. (2001). A conceptual framework and a toolkit for supporting the rapid prototyping of context-aware applications. Human-Computer Interaction, 16, 97-166.

2 Dourish, P. (2004). What we talk about when we talk about context. Personal and Ubiquitous Computing, 8, 19-30.

user-product interaction are not just the physical parts of the world, but are the meanings that parts of the context have to the user. These meanings are not stable or fixed, and are not independent of that user, but defined as relations between the user and the context. Watching a display with a group of people in a room could mean someone is in a meeting. But it can also mean he or she is watching a movie, or showing holiday pictures. These differences can be the source of confusion in communicating between social scientists and engineers but more importantly they imply radically different ways of thinking about what products should do. At present there is no single way to integrate the two views and therefore both should be kept in mind when designing context aware applications.

This said, there are examples in which just simply being aware of location can change the way we interact with products in a positive way. A location aware digital camera for example will provide people with photo's that can be easily sorted by place they were taken. This will make retrieving a photo from the ever growing collection of digital pictures much easier. Early examples of this can be found on the internet[3]. A location aware mobile phone will make it possible to invite all your friends who are close by, for a drink at a local pub, with just one single text message. These examples show that good context aware design is not about using all technological possibilities but about using a limited set of sensing technologies in an intelligent way.

dedicated utilitarian LAC applications

Dedicated utilitarian LAC applications link the physical location to information about the physical world to help people with utilitarian locating tasks, such as getting to a specific location, person or service. These applications usually have the form of an interactive map. Because they can not exist without location sensing technology, they are labelled "dedicated". The best known examples are car navigation systems (for example Tomtom[4] car navigators), applications for walking tourists (for example Timespots[5]) and personal navigators for hiking (for example Garmin eTrex[6]) These applications use different interaction (use of visual map, type of map, spoken guidance) for different contexts of use (mode of transport, type of terrain). The applications use detailed maps of the physical world in order to arrive at the predetermined location.

With the availability of these highly detailed digital maps like Google maps, Google earth and MSN Virtual Earth, people are starting to use them for other things than finding locations, persons or services. They add extra layers of information to the map to tell stories, often with a personal character (for example memory maps flickr[7]).

Having similar interactive and detailed maps on your phone or PDA is only a small step away. This will provide a user with a highly detailed navigation system, which can be used to make, share and read personal annotations to locations in the physical world, but most likely in a

3 www.vantilburg.us/Plotter/index.htm

4 www.tomtom.com

5 www.timespots.com

6 www.garmin.com/products/etrex/

7 www.flickr.com/photos/tags/memorymaps/clusters

limited way. Using detailed and interactive maps comes very close to dedicated entertainment LAC applications.

dedicated entertainment LAC applications

Dedicated entertainment LAC applications link the physical location to media in order to entertain people. The same detailed maps of the physical world are used, but extra layers are added. The aim is not to arrive at a predetermined destination, but to enjoy exploring these extra layers of annotations, stories, music and games by moving around in the physical world. The Experience of such collections of media changes depending on a person's location in the physical world can be considered a mediascape. The first examples can be found in museum tours, virtual graffiti and research projects such as 'Mobile Bristol'. However, these first examples make use of existing devices: the mediascape experience is designed using only existing devices.

conclusions

+ Two fundamentally different philosophical viewpoints exist on what is context. Although the differences sometimes lead to misunderstandings when context aware computing applications are developed, they both provide useful insights. Both ways of looking at location aware computing will therefore be used in this project.
+ Just like their utilitarian counterparts, dedicated entertaining LAC applications will need to provide different interactions for different contexts of use.
+ There are no dedicated devices which are designed as an integral part of the mediascape (dedicated entertainment applications) experiences.

This knowledge of the interactions and the key attractions which the device needs to facilitate will form the base for the device design.

1.4 designing a device as part of mediascape experiences

When approaching mediascape device design from a user centred perspective, it soon becomes clear that the overall mediascape experience is what is of importance to the user. Take a tourist on an interactive tour of Amsterdam, for instance. Via a device he or she receives stories about the buildings while walking along side the canals. If a poorly designed interactive tour is used, the tourist will undergo an unpleasant experience, regardless of how well the device is designed.

On the other hand, a badly designed device will limit the possibilities of experiencing a mediascape to the fullest. But this is where the designer has some control: the device itself, the content (the mediascape) and the technological infrastructure (i.e. all parts that can be designed) can be carefully developed and manufactured. Yet there are many aspects, subjective as well as contextual, that influence a mediascape experience over which developers have little to no control. And because most mediascape experiences have a situated nature (the content has a close relationship to the location in which it is placed), the context becomes even more important than with other interactive experiences. For example, if, due to the weather, the tourist cannot see certain buildings mentioned in the tour, that part of the interactive tour will become useless, and maybe even confusing for the other parts of the tour.

So how to design a dedicated device as part of a mediascape experience?

In this master thesis project, existing and potential mediascape experiences will be collected, categorized and analyzed from a user centred perspective. The aim is threefold:

+ To understand what the key attractions are of mediascape experiences and what interactions are needed for a user to enjoy the mediascape fully.
+ To understand the interactions between the user and the virtual elements as well as the physical elements that make up a mediascape.
+ To understand the interaction between the user and other people.

This knowledge of the interactions and key attractions the device forms the base for the device design.

1.5 project brief

By designing a dedicated mediascape device this master thesis project will encompass three specific stages. The first stage is to study existing and possible applications for mediascapes from a user centred perspective through desk research and experiential research. From this, key attractions to mediascape experiences and interactions present in mediascape experiences are identified. In the second stage the development of location aware computing technology within the next five years is analyzed to investigate the possibilities as well as limitations of future mediascape experiences. The third stage will consist of the design of a product concept that facilitates the attractions and interactions of future mediascape experiences. As such, the goal of this project is to explore the product design implications of mediascape experiences by designing a dedicated mediascape device.

2. mediascape experiences

Although there is an ongoing discussion and exploration within HP Labs of the boundaries of what a mediascape experience is, there is agreement on the following definition:

'A mediascape experience is a mixed reality experience in which the visitor is presented with digital media (such as text, images, sound, and/or video) depending on their travels through the physical world.'*

* In the remainder of this document the people experiencing a mediascape will be called visitors to emphasize the fact that they have to physically go somewhere to experience it.

2.1 mediascape experience genres

Mediascapes experiences come in many different forms. New mediacapes emerging in the next five years will result in even more different forms. An obvious trap is to design a device that tries to facilitate all of these (possible) mediascapes to all potential visitors. Such a general device will most likely facilitate none of the mediascapes very well. Consequently, a dedicated device should only provide for the experience of some of the mediascapes. Therefore, the broad range of potential mediascape experiences has been investigated and grouped. Mediascapes have been categorized on the basis of similar interaction models. An interaction model describes what the visitor needs to do to experience a particular mediascape to the fullest. Mediascape experiences with similar interaction models are labelled "genres".

In order for the device to be an integral part of the mediascape experience it needs to facilitate the attractions of the experience. User research done previous within the mobile Bristol project helped to identify many of such attractions, but also personal experiences of mediascapes (see appendix A). Therefore, next to the interaction model, attractions and examples of existing mediascape experiences are described within each genre.

active mobility 'tours'

The visitor is free to walk around a city, museum or heritage site and is presented with the option of receiving information on augmented objects (works of art or buildings) in their direct surroundings.

interaction model

The visitor moves in a clearly defined part of the physical world to receive augmentations of clearly identifiable static objects (works of art, buildings) when moving close to one of them. The augmentations are often divided into several levels to cater to the different interests and knowledge levels of different visitors. A visitor uses the device to select the level that interests him/her the most. In some cases the visitors can record their own experiences during the 'tour'. These recordings are used as a memento or becomes an integral part of the mediascape to be experienced by other visitors.

The term 'tours' implies providing content in a guided linear way. But in active interactive museum guides this is often not the case. The visitors are free to explore and see which object interests them before receiving information. In tourist guides the visitor is sometimes partly guided but always has the freedom to explore.

example project: Tate Modern's multi media tour

'Tate Modern's Bafta-award winning Multimedia Tour is a unique way for visitors to find out more about the art on display. Holding a small computer as you walk through the galleries, you can see videos and still images that provide additional context for the art, take part in interactive games and opinion polls, listen to commentaries, and play art-related music. You can also bookmark interesting information so that further details can be automatically emailed to you at home.'

Tate multimedia tour by Antenna Audio

other example projects:

Blitze Gidsen	www.lottemeijer.com/blitzegidsen/
Bristol Explore tour	www.at-bristol.org.uk/
Mudlarking	www.futurelab.org.uk/showcase/mudlarking/mudlarking.htm

See also the 'Electronic guidebook forum, 2001'[1] and appendix B for research on these and other active mobility tours.

attractions

+ The freedom and simple interaction of walking to the object you are interested in to receive information about it.
+ Information (i.e. the augmentations) is presented in separate and different levels. The visitor can easily select only the information he finds interesting.
+ The visitor can receive additional information about indicated displays when he or she returns home.
+ The visitor can become co-author and share his personal experience with other visitors which then will become an integral part of their mediascape experiences.

situated stories

A visitor walks around to find situated stories. A situated story is a (fictional or true) story about things that happened in a specific location, situated in that same location.

interaction model

The visitor moves through not clearly defined parts of the physical world in search of augmented stories on a subject. Physical objects as well as physical objects that used to be in a specific location can be augmented (for example: 'This is where …used to be'). This makes finding all stories difficult. Maps, guided tours or hints can be used to find stories.

examples:

WWII stories (will be developed within the Mobile Bristol project)
Old sense of place (Fleuriot, forthcoming)

attractions

+ Placing a story in the location where it takes (or took) place enhances the relationship between the story and the present
+ The freedom and simple interaction of walking to the object you are interested in to find a story.
+ Elements of the virtual story, the physical present and the visitors' imagination can merge into one. These so-called magic moments are often vividly remembered by visitors (Reid, 2005[2]).
+ For people who know the location, situated stories can provide a new perspective on familiar surroundings.

1 Electronic Guidebook Research Project page, 2003 (http://www.exploratorium.edu/guidebook)

2 Reid, J., Hull, R., Cater, K. and Fleuriot, C. (2005). Magic Moments in Situated Mediascapes. ACM SIGCHI International Conference on Advances in Computer Entertainment Technology (ACE 2005), New York, USA: ACM.

passive mobility tours

Visitors move from place to place (by bus, train, boat) on a set route and receive information on augmented objects they pass.

interaction model

The visitor is moving from place to place without having any control over where he or she goes. Just as with the active mobility tours the visitor can select between multiple levels of information on each subject to find the one he or she finds most interesting.

Because most of these tours are on a strict time schedule a simple timer used to trigger the different pieces of media can replace the location sensing technology. In principle, this excludes them from being a mediascape. So one of the essential aspects of mediascapes, not included in the definition, is the visitor's freedom in selecting where to go.

example project: Node harbour tour

'Using portable, handheld technology in a broadband wireless environment, visitors will be able to access the rich history of the Bristol docks, learn from compelling natural history information, hear fascinating narratives about the harbour side, and interact with each other and with the ferry staff.'
www.mobilebristol.com

other examples:

Atelier HSL www.atelierhsl.nl./index_mac_fe.html

attractions

+ The visitors' journey is enriched with augmentations on objects surrounding him without the need to search for the right information.
+ nformation (i.e. the augmentations) is presented in separate and different levels. The visitor can easily select only the information he finds interesting.
+ The visitor can receive additional information about selected places when he or she returns home.
+ The visitor can become co-author and share his personal experience with other visitors which then will become an integral part of their mediascape experiences.

location based games (LBGs)

Location based game players use the physical world as a playing field on which to play mixed reality games with elements from both the physical playground as well as from computer games.

interaction model

Players move through the physical world to move their avatar through the virtual part of the game world. Game elements (characters, objects, areas and avatars) mostly exist only in the virtual part of the game world. Locating, navigating and manipulating these virtual game

elements happens by interacting with the device. Location based games vary from being situated, i.e. having a close relationship to its physical location, to games that can be played anywhere where enough space is available.

example project: 'Demor'

'As soon as the game starts, the player finds himself situated in the center of a 3D audio shooting game. He can then move through the auditory surroundings and hear sounds coming from his left, right and the direction in which he is heading, and which can come from close-by, a distance and any space in between. The objects that produce these sounds are - among other things - the bad guys, the surroundings and ammunition.'
http://student-kmt.hku.nl/~g7/site/index_.html

other examples:

Can you see me now?	www.blasttheory.co.uk
The journey	http://journey.mopius.com/
Viennen por ellas	www.vienenporellas.cl/01.htm

Level Climbing (see appendix C).
Balance (see appendix C).
For more location based games see the in-duce website: www.in-duce.net

attractions

+ By mixing elements of virtual and physical reality new type of game worlds and play emerge.
+ These new types of games offer attractions common to any form of game play, like social play and competition as well as attractions particular to mixed reality games, like magic moments.
+ When the two parts of the game world merge into one magic moments can occur.
+ The simple interaction of walking around to move your avatar in the game.
+ Players can use new technology as an excuse to play like a child again.

interactive media plays

In this form of non-linear storytelling the visitor walks around to find pieces of media through which a story starts to unfold.

interaction model

Visitors explore a part of the physical world to experience an alternate reality that has a relationship to the physical location in which it is situated. The exploration starts out as an insight into this alternate world, but after a while storylines and characters begin to emerge. Visitors can start to follow storylines and characters. However, interactive non-linear story telling is just starting to emerge and is very difficult to construct and write (Blythe[3]).

3 Blythe, M., Reid, J., Wright, P. and Geelhoed, E. (2006). Interdisciplinary criticism: analysing the experience of riot! a location-sensitive digital narrative. Behaviour & Information Technology, 25, 2 (March- April), 127-139.


PRO-LUXE
PRO-40

example project: Riot! 1831

'Imagine a play for voices. It is the Bristol Riots of 1831. The Political Reform Bill has been defeated in Parliament and the vote denied once more to ordinary people. Now those people are rising up and thousands of them have filled Queen Square in the heart of the city to vent their fury. You hear the rioters' voices as they plunder the surrounding buildings, the flames as buildings burn, the merchants as they flee for their lives and the Dragoon Guards as they sabre-charge through the crowds cutting the rioters down.'
www.mobilebristol.com/flash.html?
www.mobilebristol.co.uk/QueenSq.html

attractions

+ The freedom of walking around to follow storylines in an alternate reality.
+ A simple interaction that evokes an experience that gradually becomes richer and richer.
+ For people who know the location, interactive media plays can provide a new perspective on familiar surroundings.

virtual graffiti

Visitors can leave their media in any location they desire. Other people can find these situated texts, audio or video messages

interaction model

The visitor is a co-author taken to the extreme. 'Mediascape' is the platform on which visitors can place content in a specific location. Visitors look for or stumble onto content (text, audio, video), and visitors can create content on the spot.

example project: urban tapestries:

'Urban Tapestries is an experimental software platform for knowledge mapping and sharing – public authoring. It combines mobile and internet technologies with geographic information systems to allow people to build relationships between places and to associate stories, information, pictures, sounds and videos with them.'

other examples:

Geonotes	http://geonotes.sics.se/
Location based sms	www.siemens.com

attraction

+ The possibilities that arise with the ability to create and leave pieces of (personal) media in a specific location. Or, in other words, the ability to create your own mediascapes.

soundscapes

Soundscapes are interactive musical compositions. Depending on the visitors travels through the physical world the music changes.

interaction model

Visitors explore an interactive music piece by moving in a clearly defined part of the physical world. Depending on the composer, the piece can range from almost fully linear to extreme interactive (bordering on manipulating the mediascape like playing a musical instrument).

example project: sonic city

'We are projecting a space of music interaction onto the physical space of the city, a constructed yet inhabited environment, made of unknown and familiar places, details and ambiences, unexpected and predictable events, fixed and fluid elements. The urban environment becomes an interface for real-time electronic music making, and urban paths become the scores of a personal soundscape of music, in which changes of context imply changes of musical structure. As a result, the city is both a setting and a means of music creation. Context parameters and urban sounds are necessary inputs to the system: the city not only enables the user to interface with and control the music, but music creation cannot happen without the city. Thus, using Sonic City is a completely contextual form of aesthetic practice.'
www.viktoria.se/fal/projects/soniccity/

other examples:

Aura	http://muio.org/projects/aura.html
Drift	www.dor.co.uk/drift/uksc.html
Moulinex	www.futuresonic.com/futuresonic/pdf/Moulinex.pdf

attractions

+ The freedom and simple interaction of walking around to change the music.
+ Feel like playing an instrument without it ever sounding wrong.
+ Having the ultimate soundtrack to your journey.

2.2 key attractions of mediascape experiences

With the large collection of mediascape experiences grouped by similar interaction model (i.e. the genres) an example genre can now be selected to design a dedicated device for. But first, the understanding of what makes a mediascape will be improved by identifying the key attractions, common to all mediascape experiences. This will also help in relating lessons learned during the design of a dedicated device for one example genre back to other genres.

The key aspects of mediascape experiences are:

+ The freedom and simple interaction of walking to access media.
+ The user can quickly select from a large collection of available media by moving around and interacting with the device.
+ Like all well 'written' media or text experiences, mediascapes can make the visitor become fully immersed in the experience.
+ Magic moments: the instances where the virtual worlds, the physical world and the visitor's imagination merge into one.

2.3 location based games as example genre

As stated before, rather than designing a device that tries to facilitate experiencing all mediascapes to all potential visitors (and therefore none well), this project focuses on a well designed device that will cater the needs of mediascapes with a similar interaction model. In other words, a dedicated device will be designed for one single genre. In doing so, the selected genre will be thoroughly explored and relevant lessons learned will be related back to the other genres. The remainder of this project will focus on the design of a dedicated device for experiencing the mediascape genre of 'location based games'.

Why Location based games?

Mediascape experiences are highly interactive when compared to most other ways of consuming media, but still most of them are relatively passive as this chapter showed. In most genres, visitors move around to find and start new pieces of media. However, when the media starts playing, visitors can either choose to consume it passively (listen to or watch it) or leave it and move somewhere else. These genres call for dedicated devices that are comfortable to carry around and offer the right type of outdoor media consumption.

The genres 'virtual graffiti' and 'LBGs' call for a more active interaction with the mediascape through a dedicated device. People using virtual graffiti will consume media placed by others, but they will also want to be able to react to it or just create and place their own media. A virtual graffiti device therefore will need to facilitate the consumption as well as the creation and placement of media. In Location based games the link between media placed by others and the motivation to react on it is even stronger. Game play within Location based games immediately evokes responses to the actions of others.

Furthermore, in location based games players manipulate virtual game elements. Or as Costikyan (Costikyan, 2002[4]) puts it; "In all games players make decisions in order to manage resources through game tokens in the pursuit of a goal. At all time they oversee the game state and make choices" Unless this 'managing resources through game tokens' can be done by just moving around, like casting spells in iMagic (Reid, forthcoming) a LBG player will interact with the device to do this.

Both virtual graffiti and LBGs offer directions to explore an elaborate interaction with a dedicated mediascape device that can be useful for future mediascape devices. However, virtual graffiti is still restricted to a rather passive consumption of the media a visitor stumbles upon. The dynamics of the interactions depend on the motivation of the visitor to respond to the media, he or she stumbles upon. In other words, is the visitor triggered to leave his or her own virtual graffiti when a piece of virtual graffiti is found?
Location based games, on the other hand, offer a unique opportunity to explore the possibilities of location aware computing. The game play of location based games rests upon the movements of the players. A player's movement and interaction immediately triggers a response with the other players, who need to move in order to sustain the game play. If not, the game play itself stops and as such the game ends. One could say that there is an intrinsic motivation to consume the media actively, otherwise the game will cease to continue. Therefore, in the scope of this project, location based games seem to be the most interesting genre

4 www.costik.com/nowords.html

'uncle roy all around you' by Blast Theory

to design a dedicated device for.

LBGs will probably also have the most rigorous use of a dedicated device of all the genres. Players will be running around, falling, bumping into things. Next to the physically stress on the device, this active engagement will call for speed and clearness as well. A player has little time to oversee the game state in both the physical and virtual world and make right choices. The design will therefore explore ruggedness in physicality and feedback that is useful to all genres.

'balance' developed during workshop ' movement in LBGs'

3. technology developments

Now the key attractions and interactions of mediascape experiences are clear and location based games has been selected as the example genre, the first stage of the project has been completed. In this second stage, the development of location aware computing technology within the next five years is analyzed to investigate the possibilities as well as limitations of future mediascape experiences. Generally, in the next five years the technologies enabling LBGs and other mediascape experiences will become firmly grounded in our everyday lives. Location sensing technology will be present in many devices and networks for mobile devices will improve and diversify.

3.1 location sensing technology

A central problem to LBGs is determining the precise physical location of the device. Researchers from both academia and industry have created numerous location-sensing systems that differ with respect to accuracy, coverage, frequency of location updates, and cost of installation and maintenance.

outdoors systems

For applications in open and outdoor areas, the Global Positioning System (GPS) is a common choice. A GPS receiver estimates a position by measuring satellite signals' time differencea of arrival. Although GPS offers near-worldwide coverage, its accuracy fluctuates between 10 and 25 meters depending on conditions (Reid, forthcoming) like atmospheric conditions and the presence of high buildings. Technological developments, like the Galileo project, 3rd generation GPS[1], Assisted GPS and sensor fusion (Hazas, 2004[2]) will improve this accuracy in the coming five years to between 1 and 3 meters.

indoors systems

Some GPS receiver manufacturers claim that eventually it can also be used indoors. But within the next five years, indoor location sensing still needs some kind of additional network infrastructure to be placed inside buildings. Selecting which technology to use, depends on whether it is preferred that the user is actively involved in triggering the information himself or this happens automatically. Active user involvement uses beacon technology: Radio Frequency Identification (RFID), infrared, barcodes, Bluetooth. In a basic use scenario the user points at an object to get the information on it. Passive user involvement using Wifi, ultrasound, ultra wideband radio works by dead reckoning: information is send by base stations and its signal strength is used to locate a device with out any involvement from the user.

It must be stated though that with powerful enough signal strength (or powerful enough cameras in the case of barcodes), technologies used for active user involvement technologies can be used for passive user involvement. Disney for example used industrial strength infrared beacons and smartly placed infrared receiver in the 'my Pal Mickey' doll. When a child carries this doll around the Walt Disney theme parks it tells stories, talks to them and provides information about rides. A different way of using beacon technology involves swapping roles. The device (or the visitor) carries the beacon and the room houses the receiver. The location information deducted from this is send back to the device by a wireless network. Although cheaper technologies will make it easier to implement the necessary infrastructure for indoor location sensing, it is expected that no clear standard will appear. Therefore devices that require to sense its location indoors needs multiple sensors.

direction and speed

A compass (preferably including a gyroscope to eliminate the effects of tilting) can provide a precise indication of the direction a user is facing. An accelerator on the other hand can provide a precise (short time) indication of acceleration and speed. Both sensors are valu-

1 Scientific American, 'Global positioning inches towards a makeover', 25-8-2005

2 Hazas, M., Scott, J. and Krumm, J. (2004). Location-Aware Computing Comes of Age. IEEE Computer, 37(2): 95-97.

my pall Mickey by the Walt Disney Company


6
5
4
4
5

able when applied individually, but put together and combined with location sensing they can make a very precise location and speed sensing device that knows which way it is facing. This is accomplished by using the information coming from two of the sensors to filter out the errors inherent in the third. Most of the uncertainties present in the technologies can be removed this way. When a clear use model (about the location or mode of transport for instance) is added to this system, a relatively fail prove system emerges. Today's car navigation systems combine such a use model with location sensing information to give the driver accurate feedback despite GPS drift and other sources of uncertainty.

3.2 media technology

Audio is the most used medium in mediascapes. It can provide all the necessary feedback for an immersive experience in the virtual world, while keeping the visitor's eyes and hands free in the physical world. Using location sensing technology, sound pieces can be placed in a location. But visitors find it difficult to relocate a piece they heard before (Fleuriot, forthcomming). Sometimes it feels more like tripping over pieces of audio instead of finding them (appendix A). Providing the visitor with 3D sound that changes like it would in the real world makes it easy to locate virtual sound sources. By using a gyroscopic compass to know which way the visitor is facing and generic head related transfer functions (HRTF) software (Loomis, 1998[3]) to imitate how sound chances with position a visitor can navigate by sound. Examples of this are navigation systems for blind people (Loomis, 2000[4]) and even a first person shooter game for blind kids called Demor (Cohen, 2004[5]).

The end goal for future mediascape technology is a mobile device that can provide both the physical and (precisely mapped) virtual world to all senses at the same time. A visitor will hear, see and feel both worlds at the same moment. Most of today's research (Thomas, 2000[6]) focuses on making it possible to look at both worlds at the same time with the help of see through head mounted displays (HMDs). Unfortunately there are too many technical problems that need to be solved for this technology to be used in location based games in the next five years.

The use of video and images on 'normal' displays as the leading media type is not advised by experienced mediascape designers (Reid, forthcoming), because it will likely turn the mixed reality experience into one that is solely focused on the virtual part via the display. However, it can be a useful supplement to audio. In the next five years liquid crystal displays (LCDs) present in most mobile devices, will be replaced by two new types. The first is the organic light emitting diode, or OLED. It is thinner and uses less power, due to absence of backlight. At the same time it has a better view angle, making it much better suited to be viewed by two or more people at the same time. Rollable displays or e-paper is the second type. Although

3 Loomis, J. M., Golledge R. G. and Klatzky, R. L. (1998). Auditory Distance Perception in Real, Virtual And Mixed Environments, 7, 193-203.

4 Loomis, J. M., Golledge, R. G. and Klatzky, R. L. (2000). GPS-based navigation systems for the visually impaired. Symposium on Low-Vision at the Meeting of the American Academy of Optometry, Orlando, FL.

5 http://student-kmt.hku.nl/~g7/site/research/Demor_resesarch.pdf

6 Thomas, B., Krul, N., Close, B. and Piekarski, W. (2002). Usability and Playability Issues for ARQuake. International Workshop on Entertainment Computing, 455-462, Makuhari, Japan.

its refresh rate and use of colour will not match the LCDs or OLEDs, products like electronic newspapers and outdoor sport equipment (polymer vision[7]) will appear that will benefit greatly from the weight and size advantages

3.3 networking technology

In order to experience all the mediascapes available, a future mediascape device will need to be connected to a network. This will prevent the mediascapes from overloading the internal memory of the device with media. A selected mediascape will be (fully or partially) downloaded or streamed to the mobile device and discarded when the visitor leaves the experience. At present the options for this are the latest mobile phone networks, like 3G, which can be accessed anywhere or local Wireless Fidelity (WiFi) networks. Although the bandwidth of phone networks is ever increasing, currently only WiFi has the capacity needed to download or stream the more elaborate mediascapes. The solution for the short range and limited availability of WiFi in the next 5 years may be found in WiMAX. This form of wireless broadband is both faster and has a larger range (several kilometres) than WiFi. At the same time mobile devices start to incorporate multiple network capabilities. So future devices are capable of using low and high bandwidth networks for different aspects of the mediascapes. Current omnipresent networks (GSM or 2G) or even digital broadcast techniques (television or radio) can provide an overview of the available mediascapes. When the mediascape is downloaded to the device, using WiFi or WiMAX, a smaller bandwidth is also useful to receive and send additional information during the experience. In location based games this involves information about other players and communication with them.

3.4 technology development conclusions

+ Location sensing will improve dramatically in the next five years, mostly by combining information from multiple sensors and way of use. At the same time the sensors involved will become smaller and cheaper.
+ Full visual augmented reality will not be feasible within the next five years.
+ A combination of GPS, gyroscopic compass, accelerator and the right software models can be used to develop very precise outdoor location sensing devices that know which way it is facing.
+ For indoor location sensing, a device needs many different forms of sensors because there is no clear standard appearing. Buildings need additional infrastructure to be able to place a mediascape indoors.
+ Most current and future mediascapes will run using existing technological infrastructure. Placing additional infrastructure would make the development of mediascape experiences much more expensive. The remainder of this project will focus on outdoor mediascapes that use GPS as location sensing technology.
+ Within the next five years, increasing computing power and smaller and cheaper compasses will make 3D audio just as available as GPS is at present day.
+ WiMAX and WiFi are the two networking technologies present in the next 5 years that can provide the (partial or full) download or streaming of the more elaborate mediascapes.

7 www.polymervision.nl

WIMAX antenna

4. vision

Designing a dedicated device for the near future requires a thorough understanding of location based gaming experiences and how they will evolve in the next five years. The attractions presented in chapter 2 will keep inspire designers to push the boundaries of mediascape experiences, and as chapter 3 has shown the technology involved will keep evolving. This will open up new possibilities for both the mediascape and the devices that can be used to experience them.

This chapter will argue how a dedicated device can differentiate itself from other devices by offering a more physical kind of LBG experiences. This chapter will present the arguments for the choice of a particular kind of LBG: a running LBG. Running LBGs will function as the vehicle for the development of a dedicated mediascape device. Because no (running-)LBGs exist that show the full potential of these games, the development of two new game concepts for running LBGs will be developed during the device design phase, presented in chapters 5 to 8. This chapter will end with stating the requirements for good running-LBGs.

4.1 vision on future mediascape design

In the future, mediascapes will evoke an increasing active and dynamic interaction. This more active interaction is not restricted to the device itself, or between the physical and the virtual worlds, but also between the visitors themselves. There are several reasons for this development.

Due to more precise and elaborate mapping of physical world and better location sensing future mediascapes will offer a closer relationship between the physical and virtual world. Because orientation can be sensed as part of more precise location sensing of the device, the visitor can navigate to virtual elements in the mediascape without an explicit need for an interactive map. If more elaborate software is added to this, the elements that make up a mediascape will eventually behave more similar to video game characters and objects. The mediascape will become even more dynamic by the increasing role of visitor as co-author. All in all, future mediascapes will evolve from a relative static collection of media that are roughly mapped to the physical world, into more closely mapped dynamic virtual worlds that change constantly.

But these future mediascapes will still need to deal with uncertainty in location sensing (Blast theory[1]) and scale difference that is also present in current mediascapes. As stated in chapter 3, location sensing accuracy will improve from 10 – 25 meters, to 1- 3 meters. This causes limitations on the mediascape design regardless of how precise the physical world is mapped. Small static objects (smaller than 3 meters) in the physical world cannot be accurately mapped. Because people are used to manipulating objects ranging from 1 centimetre to 3 meters a scale difference arises between the possibilities of the virtual world and the experience of people. Moving physical world objects (with the exception of players) will still be impossible to map. For LBGs this means that avatars will have a minimum diameter of 3 meters in order to maintain a constant game play. Scale difference can cause the player not be seen physically (hiding behind object) but being sensed by game device.

Therefore, LBGs will be restricted to the outdoor arena for at least the next five years. In chapter two, freedom of movement and manoeuvring has been identified as an essential attraction of mediascape experiences. This offers good opportunities to exploit the restrictions of experiencing mediascapes outdoors. More specifically, running LBG's seem to be the most promising variant of LBGs to combine the outdoor nature, the freedom of moving and the dynamic interaction.

In conclusion, mediascapes will change from static virtual augmentation with little software based on roughly mapped physical world to a very dynamic situated virtual world based on more precise mapping and locally additional mapping. This will make mediascapes more dynamic: manipulating moving virtual objects and characters will become a more inherent part of LBGs.

1 Benford, S., Anastasi, R., Flintham, M., Drozd, A., Crabtree, A., Greenhalgh, C., Tandavanitj, N., Adams, M., Row-Farr, J. (2003). Coping with uncertainty in a location-based game. IEEE Pervasive Computing, September 2003, 34041, IEEE.

4.2 vision on future location based gaming devices

In the next 5 years more and more mobile devices will be able to sense their location in the physical world. It will therefore be possible to play location based games on mobile phones, PDAs, portable game consoles, etc. Most of these devices are designed in such a way that they are mobile in the sense that they are easy to take with you, but to interact with them requires the user to stay in one place. This one place itself can be moving, sitting on a bus for instance, but the user is not actively navigating or negotiating traffic.

This device design for static and passive dynamic mobility (Hoefnagels, 2003[2]) will also reflect on the type of LBG experiences that will emerge using these devices. Players will probably move to certain location, interact with the device (solve a situated puzzle and receive a clue, for instance) and move to a new location (using the clue) before interacting with the device again.

A dedicated location based gaming device, as being designed in this project, will have to facilitate a better or different LBG experience, in order to be successful. By optimizing the device for making game decisions while running (dynamic mobility), it will move away from treasure hunt and other types of static mobility gaming experiences and facilitate a gaming experience closer to playground games and sports.

4.3 example running location based games

Most existing LBG are developed with only one of two aims in mind: create a game that is fun to play or create a game that test current technological possibilities. The first kind almost never uses the technological possibilities to the fullest. Often LBGs can be experienced using technology that is not specific to the area of Location Aware Computing. The second kind of LBG neglects the experience of playing a game when pushing the boundaries of technological solutions.

Existing LBGs are fun to play with but do not rely on location sensing in the final game. They start out as LBG concept with a too high expectation on what is technically feasible. And in the end they evolve using other solutions than location aware computing technologies to make game work. These type of games are interesting for their game play and social interaction. But because they do not take the limitations of LBG technology into account they can not be used as game examples to design the dedicated device for.

The device design in this project needs examples of running LBGs to provide more insight into the interactions that the dedicated running-LBG device will need to facilitate. Unfortunately, such games do not yet exist. Therefore, the design of the device started with the development of a running LBGs game concept, at the same informing and aiding the design process of a dedicated mediascape device. This example game concept will need to show the full potential of running LBGs in comply with the vision described in this chapter. This means offering a game experience that exploits future technical possibilities and forces players to make interact dynamically, i.e. making game decisions while running.

2 Hoefnagels, S. (2003). Designing for a frictionless mobile lifestyle. Hewlett-Packard Laboratories: Bristol, UK, February 2003.

4.4 running LBG requirements

What makes a good running LBG?

+ A good running LBG combines the attractions of social and/or physical play of playground games and sports with the networking and computing capabilities of computer games. Computing capabilities like automating complex rules, autonomous game characters and networked communication.
+ A good LBG is only fun when played as a LBG, not as an outdoor/playground game without any computing device. Neither would it be fun to play it as computer game without physically moving around.
+ A good LBG facilitates magic moments.
+ A good LBG forces the player(s) to make game decisions while running and walking.

To conclude, a good running LBG

+ Facilitates physical play
+ Exploits networked capabilities of device(s)
+ Exploits computing capabilities of device(s)
+ Facilitates magic moments.
+ Uses (semi) public space as playing field
+ Forces the player(s) to make game decisions while walking and running

4.5 conclusions

+ Location based games and other mediascapes will become closer mapped to the physical world and more dynamic but scale difference and uncertainty remains.
+ Future developments inform us that many devices will become capable of playing LBGs. The dedicated device differentiates by offering running LBG experience: a mobile game experience closer related to sports and outdoor/playground games.
+ Current LBGs (and concepts) are too bound by (or focused on) technology to show full potential of LBG experiences, therefore there is a need for (running) LBG concepts to show this potential in context.


POLACK BROS.
CIRCUS

5-8. design

device design through two game concepts

Chapter 5 to 8 present the device design through two game concepts that show the potential of future running LBGs. These game concepts combined, cover a range of game elements and interactions that will form the basis for the device design.

The first game concept to be developed, called 'Race anywhere' lets a player set up a running track anywhere by placing virtual markers. This virtual track, offers individual perpetual play and interactions with other players over time.

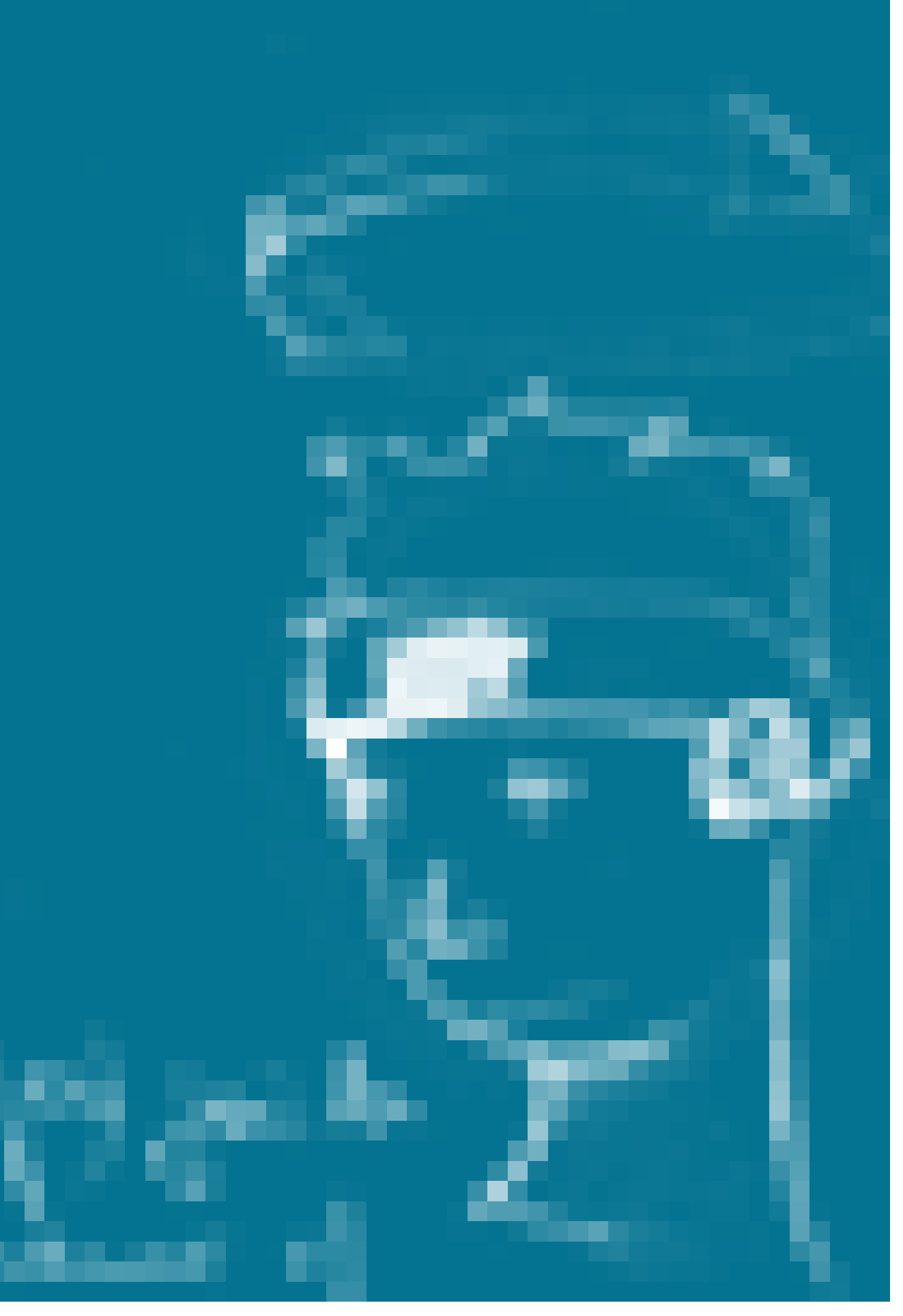
Race anywhere and its potential user group of amateur athletes were analyzed to generate device and interaction ideas that facilitate magic moments and making game decisions while running. The aim was to find ways that provide the player with relevant information from both the virtual and the physical world at the same time, while running. The most promissing ideas, combined into a concept, provide the player with a duo-device that facilitates manipulation of virtual game elements through gestures and is comfortable to interact with while running.

During the development of the duo-device it became apparent that 'Race anywhere' covered only a selected range of interactions common to running LBGs. Being an individual, perpetual game experience with limited manipulation of virtual game elements it missed out on social gaming aspects as well as many interactions with the virtual part of the game generic to running LBGs. These aspects are all present in the second game concept called 'Captivate the crowd'.

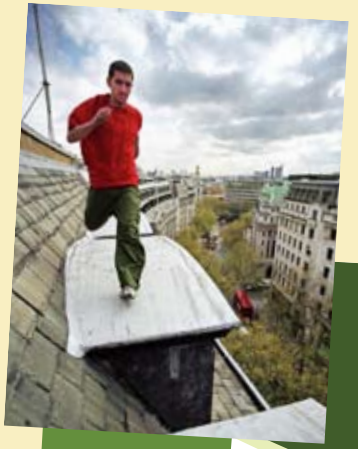
'Captivate the crowd' is a LBG version of the well known capture the flag game. It offers face to face contests, involving multiple players in a clearly defined situated playing field.

Captivate the crowd was analyzed to further develop the duo-device concept. In order to get a good understanding of the interaction between player and device, but also between player and other players in its context, a storyboard of a potential game of 'Captivate the crowd' was developed and analyzed. The result was a list of design requirements that contained a series actions generic to running LBGs, that will be triggered by gestures.

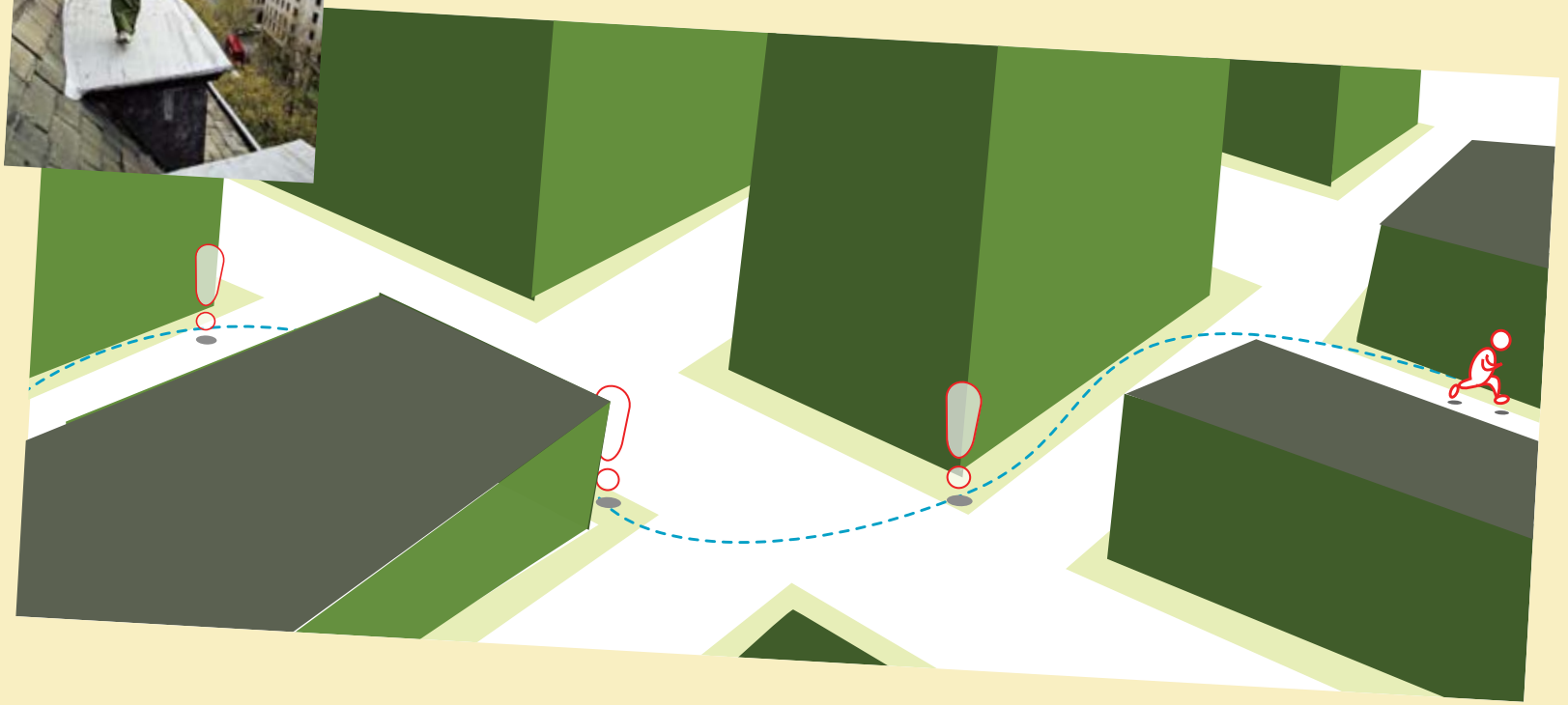
The duo-device was developed to guide and sense these and other gestures that trigger all generic running LBG actions. The final design concept called neXus, facilitates all running LBGs with playful gestural interaction and thereby turns the city into a mixed reality playground.



5.



///race //anywhere



Game concept

A player uses a device to set up a racetrack anywhere by placing virtual track markers. These markers indicate the start and finish of the track as well as intermediate points that have to be passed to complete the track. The same device will be used to race on these virtual tracks. Tracks can be shared to compete with other runners virtually or be used to improve your own performance by racing oneself in the form of a 'ghost runner'. While running on a track, a player will get information on where to go and distance between him and other virtual runners.

Location

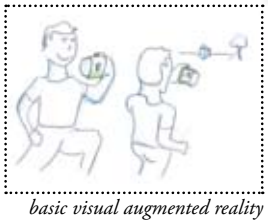
Race anywhere will be played in an urban environment. Inspiration can be found in subcultures that use the city as a playground/ playing field such as inline skating, Freestyle Parkour (combination of running and acrobatics), bike messenger racing and skate boarding. The scope of the game might in the future be extended to race anywhere in a rural environment, like for instance cross country running or mountain biking. But for this project the focus will be on (semi-) public space in the city as playground.

5.1 idea generation

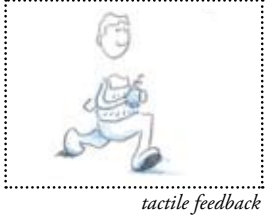
The first ideas explore a key design aspect of running LBGs: how to provide a running player with relevant information from the virtual and physical part of the game world at the same time? Both magic moments and making game decisions rely on a player being able to sense and process this information both at the same time.

idea sketches

Race anywhere provides magic moments with a simple but elegant merger of the physical world obstacles to negotiate and the virtual track to follow. Another virtual element that provides magic moments is the virtual competition. If designed right, they will give you the feeling that you are racing them on the same track at the same time. This will motivate you to go faster by wanting to beat them. The first ideas (see sketches) explored several ways of receiving information from the virtual part of the game world while running. These options are discussed in the following subparagraphs.

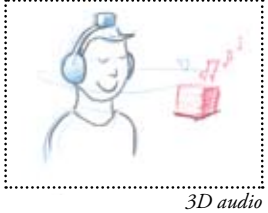


basic visual augmented reality



tactile feedback

visual infromation at a glance



3D audio

game extensions

basic visual augmented reality

Basic visual augmented reality provides the player with a view of the physical world on which virtual game elements are projected. In the case of 'Race anywhere', these virtual game elements are the markers and the virtual opponents. This visual augmented reality technology is much less sophisticated than the head mounted displays mentioned in chapter 3. It uses direction sensing in only one plane of movement. The player can point to the horizon in all directions to locate virtual objects. When moving the device up or down, the virtual elements stay in the same place. Only when pointed fully up or down, the marker will disappear from the screen. This way the player can quickly glance at the display and see in what direction the next marker is located.

tactile feedback

Tactile feedback lets the player feel on his feet, torso or in his hand where to go to find the next marker. Although tactile feedback on it's own will not be enough to make the virtual opponents and other game characters come to life, it does provide quick information on where to go while leaving the eyes and ears free.

visual information at a glance

Visual information at a glance provides all the information needed to make game decisions in a way that can be quickly 'read' while running. The 'display' is placed on a part of the body in a way that it can be easily looked at while running, for instance on the forearm or upper leg. In 'Race anywhere' the player for example only needs to look slightly down at his trousers to see in what direction he can find the next marker by noticing the difference between the indications on his left and right leg. The colour changes indicate how close the virtual opposition is.

3D audio

As discussed in chapter 3, 3D audio allows the player to locate virtual game elements by sound. This way elaborate mixed reality worlds including characters can be explored while the player is still enabled to negotiate the physical world by sight. Besides headphones, a small head tracker is needed to sense the orientation.

game extensions

Existing mobile devices are placed inside game extensions to add all functionality to them that is needed in running LBGs, like direction sensing and different kinds of feedback as mentioned before. As such this group does not present a different way of receiving informa-

tion from the virtual world, but an interesting way of integrating multiple solutions by using the computing power of existing mobile devices.

Besides exploring options for receiving information from the virtual part of the game world, the first ideas also explored options for the manipulation of virtual game elements. This resulted in two groups of design directions. On the one hand a group of design directions based on an object and on the other hand a group of design directions based on movement.

object based design directions:

small controller object

By using a small controller object, players can quickly manipulate virtual elements even while they are running. The controller is easy to carry because of it's small size. A disadvantage of a small controller object is however the fact that the interactions of the player with the virtual part of the game world are not visible for other players.

small controller object

large controller object

Using a large controller object will suit certain game styles and themes, like using a magic wand in a wizard play. The use of a large controller object also makes the interaction of the player with the virtual part of the game world visible to other players. In running LBGs, as well as in physical games, it is important for players to see each other's actions in order to quickly react. This also increases the merger of the virtual and physical parts of the game world. In some running LBGs, for example 'Race anywhere', running is the most important item of the game. For this type of LBGs a device is needed that can be comfortable carried while running: in this case a large object is a disadvantage.

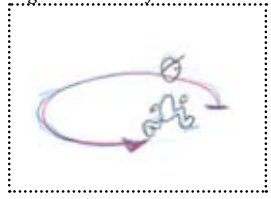
large controller object

movement based design directions:

In order to emphasize movement as the essential aspect that sets running LBGs apart from other LBGing types, body movement in different forms can be used to manipulate virtual game elements. This results in the following movement based design directions:

move in shapes

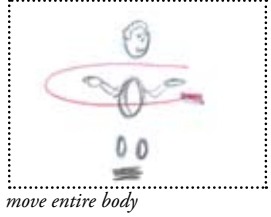
When the player moves in a shape, the device recognizes this and in turn it triggers the manipulation of virtual game elements. Because of the size of the movements this is especially well suited to manipulate areas and large objects. The advantage is that the player does not need to interact with the device. But he does need to complete the shape before he can move somewhere else.



move in shpaes

move entire body

The player moves his entire body to manipulate virtual game elements. In order to be able to sense these movements with an affordable small device(s), the number of movements will have to be limited. This means suitable movements will have to be developed for all manipulations (of virtual game elements) generic to running LBGs.



move entire body

make arm/hand gestures

make arm/hand gestures

The player moves his arm and/or hand to manipulate virtual game elements. Similar to movements of the entire body the number of gestures need to be limited. When developed right, these gestures can be performed while moving somewhere. This lets the player manipulate virtual elements on the go.

Now a game concept and first design directions for the dedicated device are in place, a group of potential players of this game, and therefore users of the device will be researched with the aim to further develop the game concept as well as making a selection from the design directions.

5.2 studying Possible Users

amateur running athlete

For 'Race Anywhere' the possible user group of amateur running athletes was researched. This target group consists of experienced runners, who might be interested in the 'Race anywhere' game concept as part of their training. During the research four such athletes were interviewed. Together with visiting running gear shops and reading magazines it provided insights into what would make 'Race anywhere' a suitable game for the target group. As running experts they also provided valuable information on the wearability of products while running.

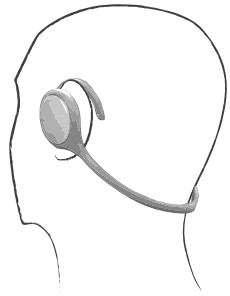
interviews

Four runners were interviewed to find out if the game would suit their running activities. They all ran personal rounds at least two times a week. The distance of these rounds varied from five to ten kilometres.

results

+ The runners expressed a great need for predictability in their training. Predictability in traffic conditions, surface conditions (steepness, hardness), safety conditions (lightning) and number of kilometres. That is why most runners have a set training round. The unpredictability of 'Race anywhere' is not appealing to them.
+ The target group would like to share tracks or daily round information with other runners to get the right information on unknown routes. In this way they can find out if it suits their training without the need of going there.
+ All runners tried running in groups and liked the social aspect. They indicate that it is very hard for them however to find people with the same ability. In fact one persons' ability differs largely from day to day, depending on health. This makes it very hard to find good running mates. For them running is about finding your own pace and improving your ability. This is why racing against other runners virtually would not work. They would just use it to improve their own ability.
+ Most runners were very outspoken about the things they wear and carry when they go running. In order of importance: shoes, clothing and a phone/watch used as stopwatch. Some of them trained using a heart rate monitor. The heart rate monitoring dic-

tated the training (running tempo) for these runners. All runners indicate that they carry as little as possible when running. Phones and mp3 players are placed tightly to arm or back, using straps or small bags, in such a way that they do not bump. Some carry them in their hand, but indicate that they prefer having their hands free.



behind the head headphones

desk research

Additional research on runners' magazines and websites provided additional information on the needs and desires of amateur running athletes.

results

+ On 'sportism.blogs.com'[1] amateur runners created a list of their needs and desires for a GPS device. These needs and desires correspond with the results from the interviews.
+ When listening to music while running, two types of headphones are popular: ear buds and headphones with a headband that is worn behind the head. The second type is shaped in such a way that it sits tightly on both ears. A small strap behind the ear keeps it from sliding down while running.
+ Many sports clothing manufacturers, are providing clothing with build in electronics, like heart rate monitors that help to optimize training. This could be seen as the first step towards the integration of electronics in clothing as researched by programs as 'the emotional wardrobe'[2].

conclusions

+ Amateur running athletes have many needs and wishes that could be perfectly fulfilled by a mobile location sensing application. This application will however be of the dedicated utilitarian type (see chapter 1) and not of the dedicated entertaining type: a LBG device. It would miss the explorative and unpredictable nature of LBGs.
+ To carry objects comfortably while running they need to be small and carried close to the body.
+ The integration of electronics in clothing provides a perfect way of doing this, but although HP-Labs Bristol is part of the design research project 'the emotional wardrobe', it is too big a departure from current day HP products to use the integration of electronics in clothing in a design concept aimed at 2011.

participant in audio experi-

1 http://sportism.blogs.com/weblog/2005/11/the_winning_gps.html
2 www.theemotionalwardrobe.com

audio experiment

A small experiment was conducted to explore the use of sound to provide virtual competition while running. One of the interviewed amateur running athletes made a mono audio recording during her daily lap. A few days later she replayed the recording while running the identical lap. What effect would this have? Would she be able to tell whether she was faster or slower?

results

+ The participant found it very hard to tell whether she was in front or behind her previous round schedule. Unexpected by runner and researcher, the identification of certain locations by sound proved very difficult. Running over wooden bridges or passing under a motorway pass over, which produce specific sounds, were not identified.
+ The only way to identify if she was in front or behind her previous round time came from remarkable things that happened when the recording was made. Moments like someone shouting at her or a bag falling from the back of a bike were clearly heard on the recording. These moments were so remarkable that she remembered where she was when they happened. This provided a way to determine whether she was in front or behind schedule.
+ The sound of someone running (feed stomping, breathing) was very powerful. The participant felt the need to start and stop at the same time and keep the same pace as in the recording. This was made more demanding by the fact that she had been ill the day before. But still she kept feeling she had to keep up.

Conclusions

+ It is hard to identify locations solely by the sound they produce.
+ Sound is a very powerful way of guiding the pace of someone running or walking.

5.3 idea selection

Based on the knowledge gained from studying possible users, through interviews, desk research and a small audio experiment, the first ideas are evaluated and design directions are selected.

manipulating the virtual world

The use of a large controller object can be suitable for specific games (and themes), but a generic running LBG device also needs to be suitable for games in which running is the main activity. In this case a large controller object is a disadvantage: it calls for as little to carry as possible.

Small controller objects can be comfortably carried in the hand and make it possible to quickly manipulate virtual game elements. Using a small controller object however makes it hard for other players to see what a player is doing and react on this.

Arm/hand gestures are the right size to make this visible and emphasize movement as the essence of running LBG's. Making manipulations of the virtual world visible in the physical world, increases the merge of the two worlds.

Larger movements of the body force the player (temporarily) to stop from directly running somewhere, which would hinder game play of games focussed on running.

selection one:

The device will use arm/hand gestures to manipulate (elements in) the virtual part of the game world.

allocating two parts of game world over senses

While running, players need to negotiate obstacles in the physical world. Visual information is best suited to do this.
Basic visual augmented reality and 3D audio can both be used to navigate through the virtual part of the game world and provide enough depth for an immersive location-based game experience. When running is the main activity of the game, 3D audio is preferred, because it enables the player to use his vision to negotiate obstacles in the physical world.
Visual info at a glance and tactile feedback are useful additions to 3D audio.
Combined tactile and 3D audio information make virtual objects come to life in a tangible way as well as in the players' imagination, while still enabling the player to navigate the physical world using his vision.

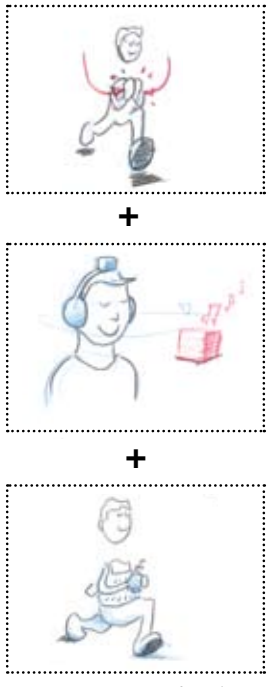
selection two:

the device will use 3D audio in combination with tactile feedback to present the player with information from the virtual part of the game world.

To provide 3D audio, a pair of headphones and orientation sensing of the head is needed. Best headphones to use while running that allow for integrated orientation sensing and other electronics are of the behind the head type.
Manipulating via gestures calls for an arm/hand controller. Using a limited number of small devices is most comfortable while running. That is why no additional tactile feedback will be used besides present in this arm/hand controller.

end result

A duo-device will be developed consisting of a pair of headphones that provide 3D audio and a hand controller to manipulate the virtual part of the game world by using gestures, which also provides tactile feedback.

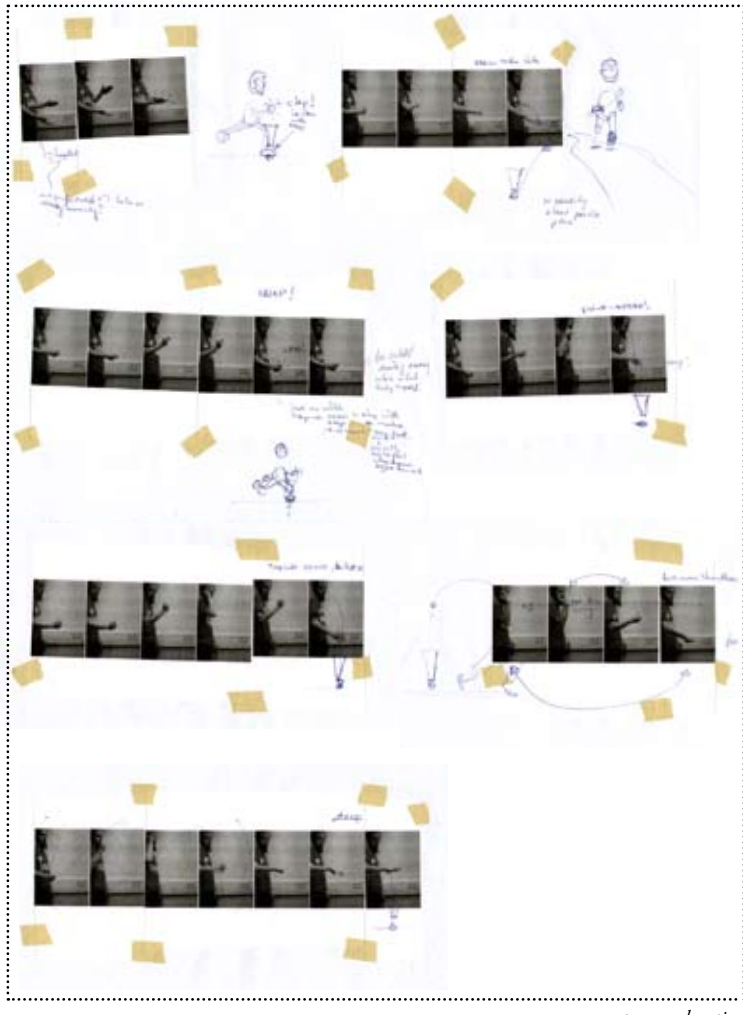


idea selection

5.4 duo-device concept

The duo-device uses 3D audio and tactile feedback to provide information about the virtual part of the game world. The player can use his vision to negotiate obstacles in the physical world. Because players receive relevant game information from both parts of the game world, the chance of magic moments occurring increases.
Besides moving your avatar through the virtual part of the game world, playing a LBG involves locating and manipulating virtual elements like objects, areas, characters and other persons' avatars. Walking/running around in the physical world makes your avatar move and in order to manipulate things the player uses arm/hand gestures. A hand controller will be used to sense these gestures. A stereo headphone will provide the player with 3D audio in order to locate virtual objects and characters. The player will be able to tell whether an object is located to the left, to the right, in front of or behind him.

For a duo-device to be able to do all this it will need to be able to sense location, compute, communicate and sense orientation. This involves hardware which will be integrated into the two devices (headphone and hand controller) that make up the duo-device.



gesture exploration

5.5 gesture exploration in 'Race Anywhere'

'Race anywhere' contains 'placing a marker' as a way to manipulate elements in the virtual part of the game world. This will form the starting point for the development of a set of gestures, which will cover all generic actions in running LBGs.

The selected 'throw down'-gesture is made in time with placing one foot on the ground. It is a relatively large gesture, comfortable and visible, which makes it clear where the marker is placed. Sound and vibration feedback are used to indicate that the placement of the marker

selected 'throwdown' gesture

is successful. The headphones provide 3D sound to make the virtual part of the game world come alive. The hand controller facilitates manipulation of virtual game elements through gestures and is comfortable to interact with while running.

5.6 conclusion

'Race anywhere' enables the player in setting up a running track anywhere he likes, by placing virtual markers. This game concept formed the foundation for the development of a duo-device. The duo-device consists of a pair of headphones and a hand controller. The 3D audio from the headphones and the tactile feedback coming from the controller makes the virtual part of the game world come alive. The hand controller facilitates manipulation of virtual game elements by using gestures and is comfortable to interact with while running. The duo-device emphasises movement and improves the connection between the virtual and physical game world by making manipulations of the virtual world visible in the physical world.

During the development of the duo-device it became apparent that 'Race anywhere' covers only a selected range of interactions common to running LBGs. It provides an individual, perpetual game experience with limited possibilities for the manipulation of virtual game elements and therefore misses out on social gaming and other forms of manipulating the virtual game world. To cover these aspects a second game concept was developed called 'Captivate the crowd'. This second game concept introduces more of the generic actions of running LBGs in a social gaming setting. It involves multiple players and therefore facilitates face to face social

play. The use of a scenario storyboard provides insights in the context in which the game play and all interactions take place.

6.

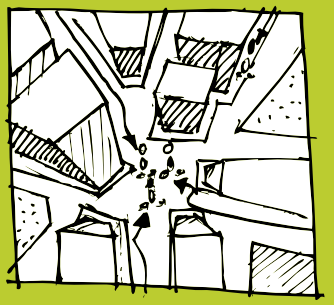

CAPTIVATE the CROWD

Captivate the crowd

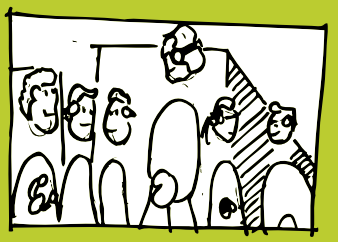
Captivate the crowd' is a location based circus version of the well known 'capture the flag' game. In this version two teams compete in building the biggest top (circus tent) by stealing tent parts of the opponent and using it to build their own tent.
What sets this version apart from other capture the flag games is that every player needs to have a virtual animal with them for most actions in the game. The animal helps him sense other players and their animal, it carries the stolen tent parts, and very importantlyl; it has the ability to scare anther players' animal! When a players' animal is scared and it flees, the player will have to re-catch it or catch a different animal before he can fully take part in the game.
The three types of animals present in this game have a 'scare-order'. The elephant scares the lion, the lion scares the mouse, and the mouse in turn scares the elephant.

The storyboard on the next pages shows a game of 'Captivate the crowd' as it could potentially be played.

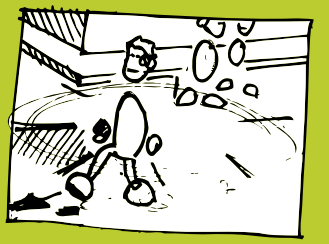
Jake and Pete want to play a game. So Jake calls Richard, who tells Bill, who texts Rob. Pete at the same time phones David and they agree to meet that afternoon.



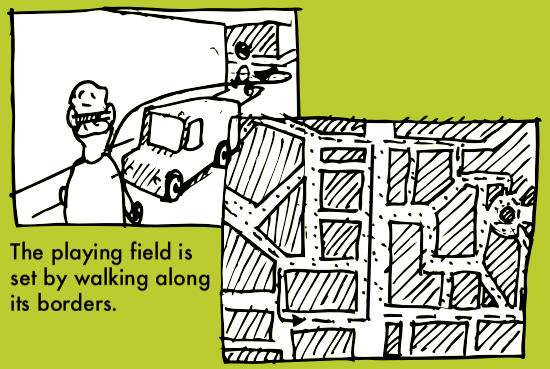
At 3 pm they meet on the corner next to the coffeeshop.



They divide into 2 teams and decide on playing field and border.

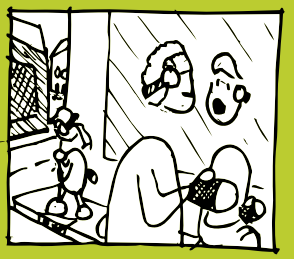


Jake sets up the game.

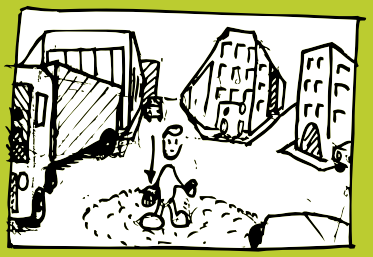


The playing field is set by walking along its borders.

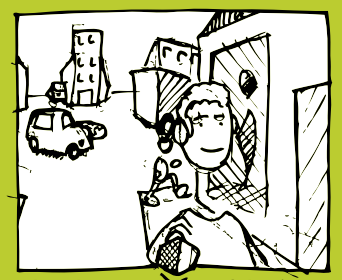
When the playingfield is set and devided into 2 halfs, one of the teams selects a half as their own.



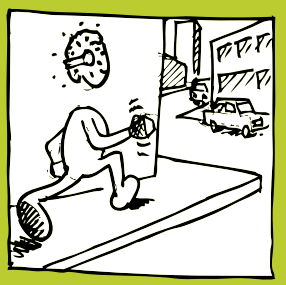
Each team goes out to look for a suitable place to hide their big top. Meanwhile keeping an eye on where their oponents are heading.



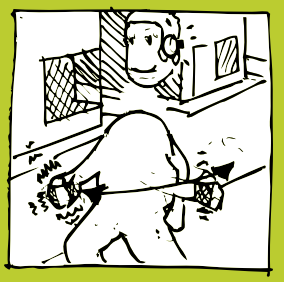
Rob of team A puts the big top in the centre of a round about, a place to easily spot oponents and hard to get to because of the traffic. Their team's background circus music starts playing



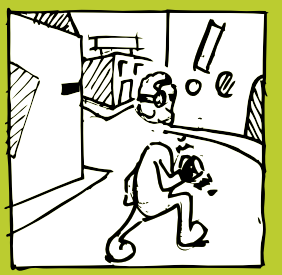
The playing of the music indicates that the animals have also arrived, so each team member goes out to look for one.



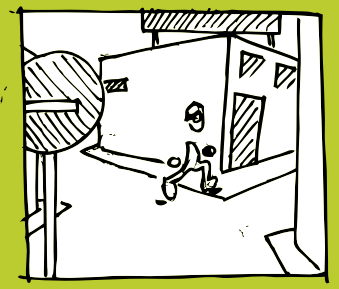
Jake is lucky. At the end of the first street he enters he feels his hand controller starting to tremble. He also hears soft breathing.



While scanning the surroundings by moving his arm from left to right, The vibration gets stronger to his right. The breathing gets louder but it's to faint to hear what direction it's comming from.



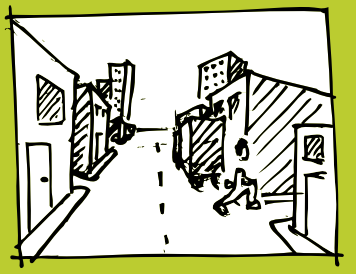
The breathing is followed by a roar, which is clearly comming from right ahead. When crossing the street he hears a metal chain and feels the trembling get in sync with the breathing of the animal Jake has just cought one of the circus lions.



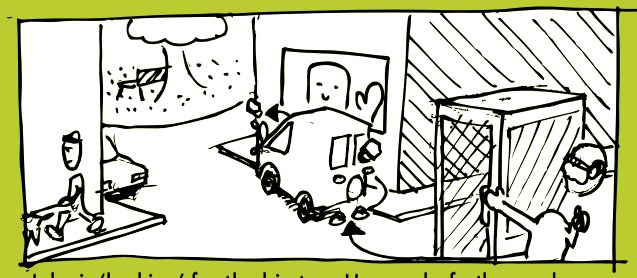
With a lion by his side, Jake heads for the border. The lions walking pace also speeds up until it is in sync with Jakes'.

Just before reaching the main street that forms the border he spots his team mate Richard. At the same time the game has started because the other team has also found a place to hide their big top.

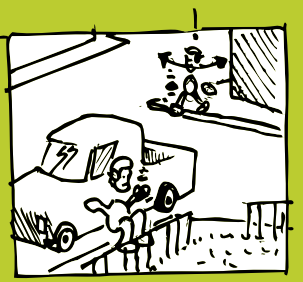
Richard has just cought one of the mice, but prefers to use a Lion. Jake doesn't mind swapping and with one handshake it is done. Since the game has just started, swapping animals has hardly an effect on their abilities.



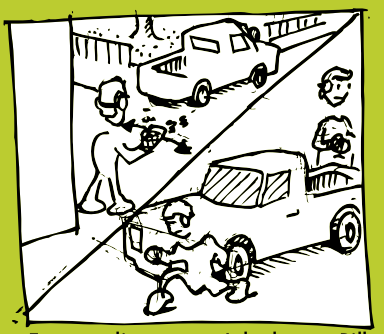
Jake immediatly crosses the border. The music changes from the now familiar circus tune of his team to an even happier one selected by team 'flying circus'.



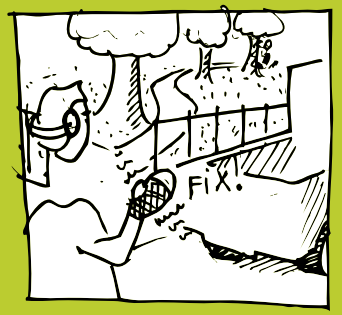
Jake is 'looking' for the big top. He sneaks further and further into the Flying Circus half. Ever causious of not being 'seen' he keeps looking around while paying close attenttion to any vibration in his glove or sound indicating a closeby animal.



Suddenly his hand controller produces a light vibration. He ducks behind a car. Through the window of the car he sees Bill appear around the corner. Bill suddenly freezes



From earlier games Jake knows Bill usually starts out with a Lion. Hoping to get away without being seen or even worse, 'get scared',Jake sneaks oto the next car and jumps a small fence entering the park.



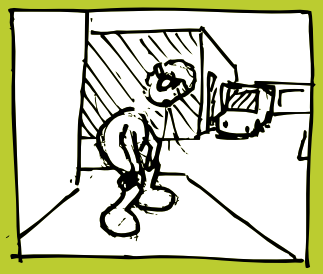
But to no avail. Bill spots him and points his glove in Jakes direction. As soon as he get's a fix, Bill releases his Lion.

just before leaving the park, Jake suddenly hears a loud roar, followed by a high scream. He knows he has been spotted and like before Bill had the lion.

The sound of a breaking metal chain follows and Jake starts running because he knows he has to catch up with his mouse before it runs past his own top and out off the game.

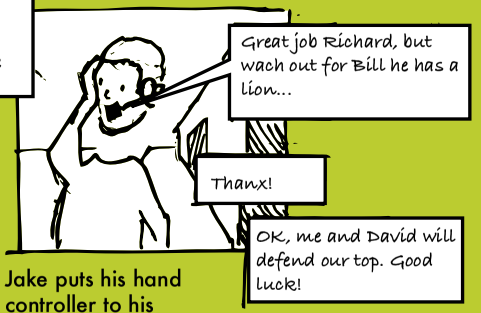
Jake starts catching up with the mouse when he crosses the border.

Just across the border Jake catches his mouse...



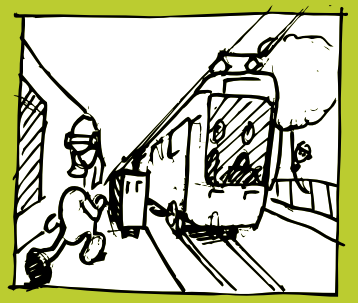
...and needs to take a breath.

A nice message from Richard...



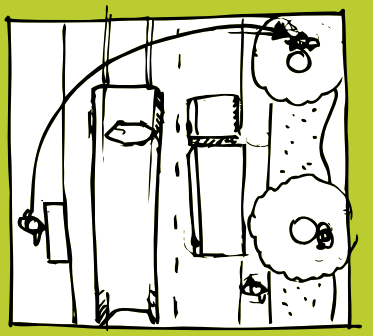
Jake puts his hand controller to his headphone and talks to both his team mates.

Richard sneaks back into Flying Circus' half and arives near their tent when he spots Joe behind one of the trees in the little park.



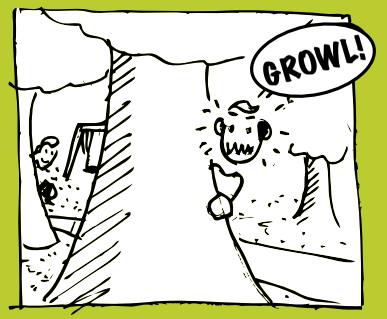
Using the passing tram as cover..

...he reaches a container standing on the sidewalk. He informs his teamamtes of his whereabouts and ask them wether it is save for him to scare Joe.

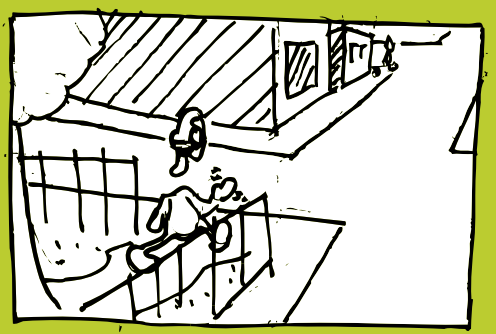


Knowing Joe probably has a mouse, he sneaks into the park without being spotted.

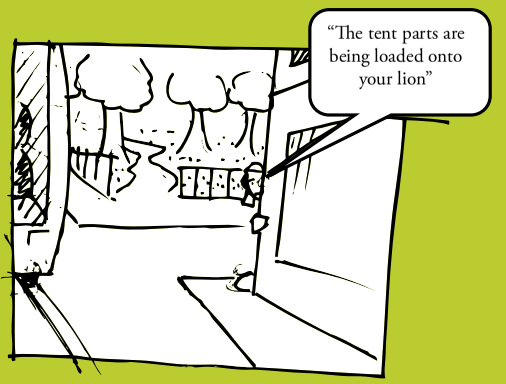
Because he is so near to Joe, his hand controller is already trembling. He can even hear the animal breathing although Joe is standing almost still. He points his glove at him..



...and releases his lion.

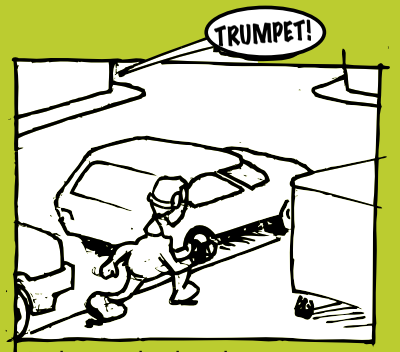


Richard wastes no time and runs toward the corner where the top is located. The sound of people erecting a tent appears.

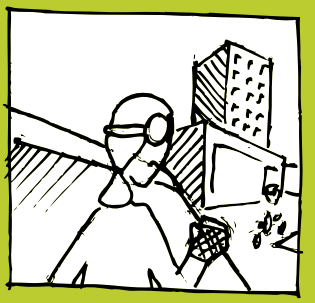


He hides just behind the corner and waits until the tent parts are loaded onto his lion.

When he crosses the border his booty is save and will be used to build an even bigger top.

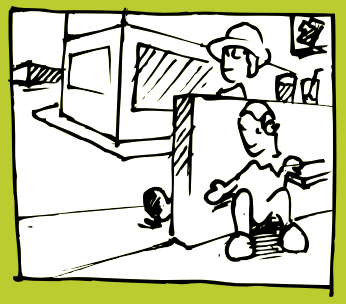


On his way back to the top, he hears a elephant noise comming from left ahead..

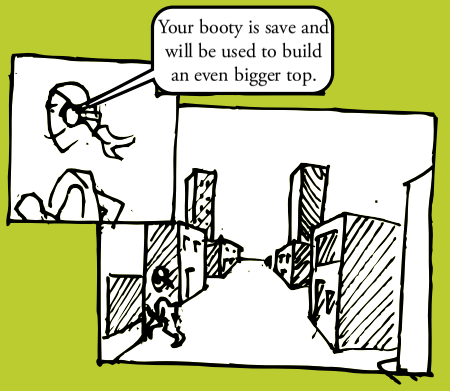


He hides behind a car and sees Jake run towards the border.

Just a few seconds later Richard hears what happened.



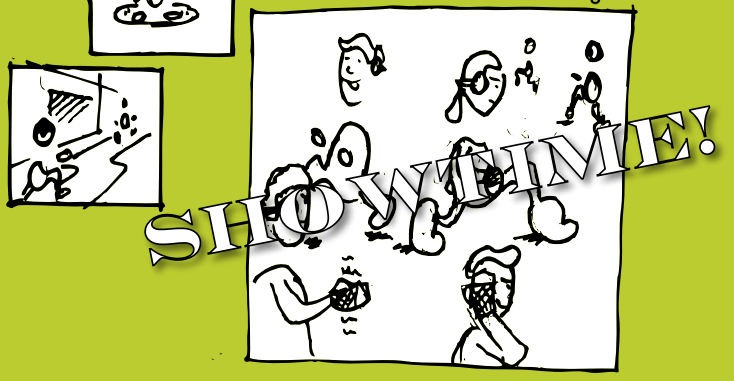
He decides to have a go at picking up the dropped booty in front of the pub and hides behind a small wall.



He succeeds and takes it to his team's half.

The game continous for another hour while the circus music gets more and more enthousiastic. With just 15 minutes to go anouncements are made that try to pull people to the comming show.

It's showtime! The game is over and the team with the biggest top has won. Find a new place to put on a show and start a new game.



spot opponent

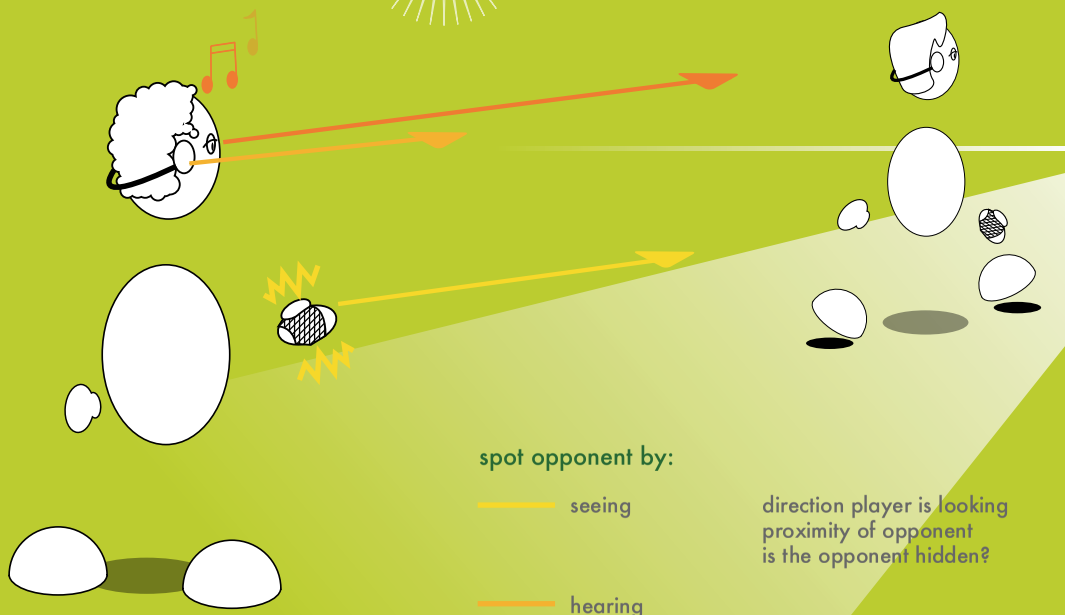
objective:

While playing 'Captivate the Crowd' players are able to get close to each other without being spotted by the opponent. This adds excitement and face-to-face interaction to the game. But in order to 'scare' an opponent's animal, the appliance needs to be able to sense an opponent is near. The game should therefore make it possible to 'scare' without resulting in accidental spotting of opponents each time a player happens to be near.

solution:

There are three ways of spotting an opponent:
By seeing the opponent
By hearing the opponent's virtual animal
By feeling the opponent's virtual animal via own animal

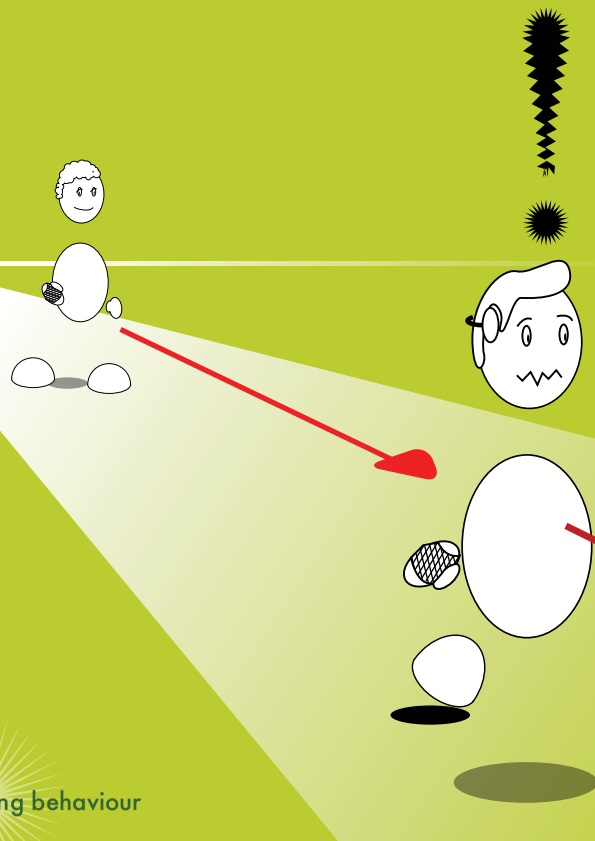
Range of spotting
When there is nothing standing in between two facing players, a player can see an opponent before he hears or feels the animal. Second in range is 'feeling' the opponent's animal. When a player wants to look for an opponent he needs to tell his animal to look for another animal, i.e. put the appliance in 'feel for - mode'. He then point his hand in the direction he wants his animal to search. Hearing another animal has the shortest range, but it is possible to hear where he is located by means of 3D sound. A player can therefore hear if he is looking in the right direction. To avoid accidentally spotting an opponent's animal each time you are near, the sound it produces is equal to the speed at which it travels.



spot opponent by:

- seeing
  - direction player is looking
  - proximity of opponent
  - is the opponent hidden?
- hearing
  - volume produced by opponent depends on his speed, high speed = high volume
  - direction player is looking/hearing
  - proximity of oponent
- feeling
  - direction player is pointing his hand
  - proximity opponent

scare opponent



As shown in the storyboard it is possible to 'spot' an opponent by sound, vision and even by vibrations in the hand controller. But this could potentially take away much of the face-to-face play. This page shows how this problem is solved in Captivate the crowd. It also shows what happens to the animal when it is scared.

Fleeing behaviour

When an animal gets scared, it will run away from the animal that scared it. After running in the scare direction for a while it will flee in the direction of its circus tent. When it is not catched, the animal will keep running, run past the tent, cross the playing field border and be out of the game.

scare direction

flee direction

OUR HALF

place top
place virtual circus tent

locate top
locate static virtual circus tent by sound

look for animal
search by sound
locate virtual animal by sound
locate virtual animal by sound and vibration
catch virtual animal animal

encounter lose animal

having no animal:

locate virtual animal by sound
locate virtual animal by sound and vibration
catch virtual animal

having animal:

lose animal scares animal

animal scares lose animal

to switch animal - let go of animal
locate virtual animal by sound
locate virtual animal by sound and vibration
catch virtual animal animal

game developments
background music/sounds start and stop
announcements about game start and approaching ending
anouncements when piece of own top get's stolen

travel with virtual animal
hold animal
walking pace (vibration + sound) and breathing (sound) synch up
hear booty move with animal

encounter team mate
switch animal - shake hands with team mate

(in team) communication
hear team mates speak
activate talk
talk to all team mates

enter other half
music changes

encounter dropped booty
stumble upon booty, sound
animal notices?

encounter opponent

locate oponent
see oponent
activate scan
scan with animal via hand
feel oponent's animal
hear oponents animal

scare oponent
point animal in direction
get fix
release animal
hear/feel animal charge
scare or get scared

audible to other players in surrounding

chase fleeing animal
hear/feel animal flee
run after animal while hearing and feeling where it's going
catch it

leave playing field
animal smells freedom
lose animal and booty
music stops, changes into...

THEIR HALF

encounter lose animal
having no animal:
not possible, have to have animal to cross border

having animal:
lose animal scares animal

lose animal avoids animal

pick up dropped booty
stumble upon booty, sound
animal notices
pick up booty

encounter top
get close to top - hear building
enter building site - sound changes
load stuff on animal

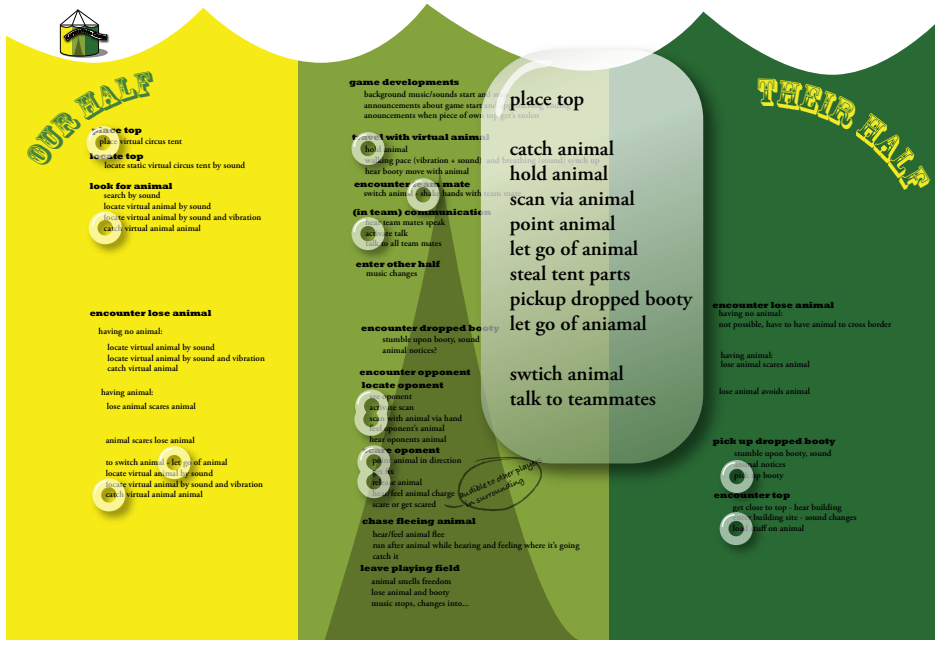
6.1 'Analyzing' Captivate the crowd

The basic rules and interactions of 'Captivate the crowd' are analyzed to identify interaction and design requirements to further develop the duo-device concept (headphone and hand controller).

interaction overview

The figure on the left shows the most important interaction moments between the player and the virtual part of the game world. These interactions have to be facilitated by the duo-device.

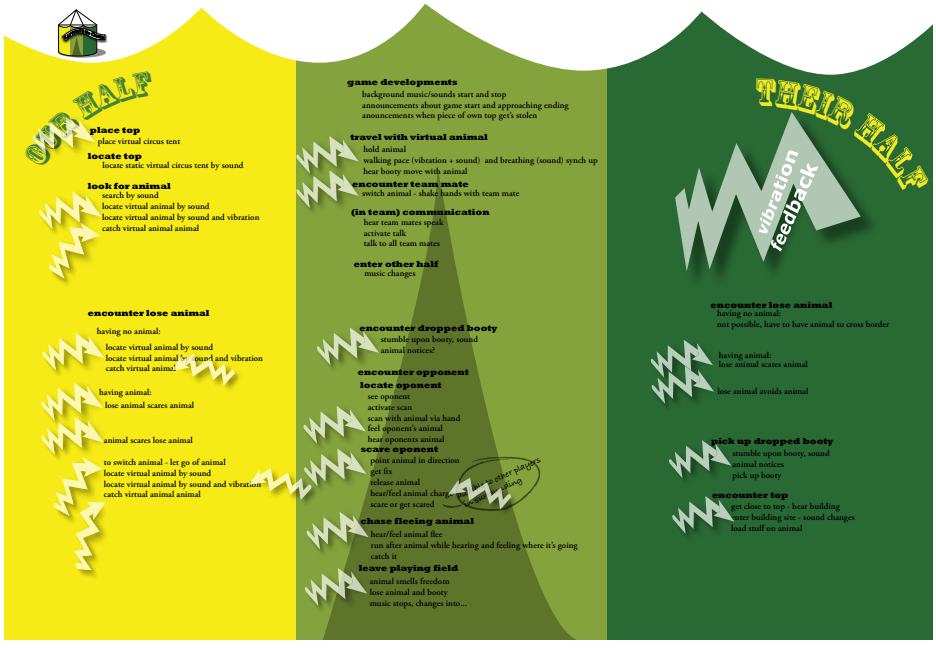
The figure is divided into 3 parts; the left part contains all the interaction moments when a player is on his own half. The part on the right contains all the interaction moments on the opponent's site. All interaction moments that are the same for both halves can be found in the middle part.



identify actions

identifying actions

On a number of occasions during 'Captivate the crowd' a player actively interacts with the duo-device to manipulate elements in the virtual part of the game world. the figure shown above identifies these moments and shows the actions that take place in the virtual world. These actions are examples of actions generic to running LBGs. Catching an animal can for example be seen as catching a moving virtual object or character. During the further development (chapter 7) of the duo-device all actions will be translated to their generic counterparts.



identify feedback

identifying feedback

The hand controller interaction is based on the idea that the hand will be the most direct connection between the player and his animal. As shown in the storyboard, the player will command the animal through gestures and receive feedback through vibration.
More general game information (like announcements, background music indicating which half you are on) will be received through the headphones. The animal will off course also produce sound which, combined with the vibration from the hand controller, provides the information needed to locate virtual animals and objects.

The vibration feedback from the animal provided by the hand controller represents either the walking pace or the heartbeat of the player's animal. The vibration and sound indicate the walking pace of the animal, when a player is holding the animal. The pace of the animal synchronizes with the players pace when he is moving. When the animal is 'looking' for other animals, the player hears it sniff and the sound of its heartbeat. The heartbeat is also tangible through the pulsating vibration in his hand. When the animal is facing another animal the heartbeat speeds up. When the animal is fully concentrated on its 'prey' and ready to scare he produces a low pitch growl and the hand controller vibrates constantly.

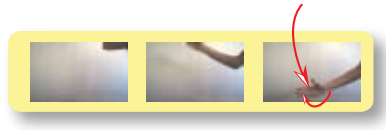
The lightning shafts in the figure shown above represent all moments at which the vibration and sound feedback from the animal changes. The exact feedback for this and other running LBGs will not be developed during the remainder of this project. For the further development of a generic running LBG duo-device it is sufficient to know that the hand controller needs to

be able to provide vibration feedback.

6.2 gesture development

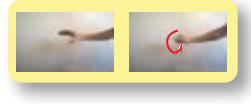
Based on the actions identified in this analysis and the gesture ideas from the storyboard a family of playful gestures was developed. Figure X shows these gestures that will be sensed by the hand controller. The aim was to develop gestures that could be used in this as well as other running LBGs. The gestures that control the animal, should be comfortable to make while running and identifiable by other players from a distance. This way, players can sense opponents' actions and react to it before it could be to late. Other gestures that trigger talking to teammates and exchanging animals will be predominantly made while staying in one place.

place top



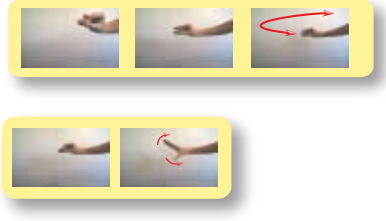
With a powerful shake, a player places the top. This gesture can also easily be made while running. This is not necessary for 'Captivate the crowd', but in other LBGs like 'Race Anywhere' it is essential to virtually tag locations on the go.

catch and hold animal



Just like catching something from the air, the player grabs the animal and holds it by keeping his fist closed.

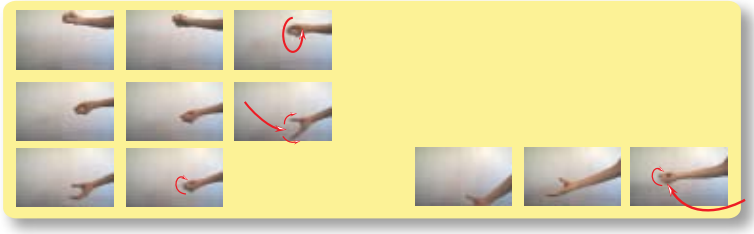
scan, point and release animal



By pointing his fingers in the direction the animal has to look and keeping his hand closed, the player tells the animal to look for other animals. When the animal is pointed in the direction of an animal of an opponent for a short while it is 'locked' on its target. The player opens his

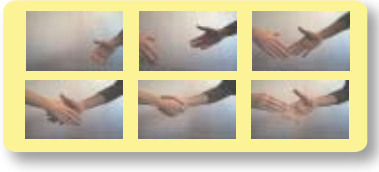
hand and the animal charges.

steal and pick up tent parts



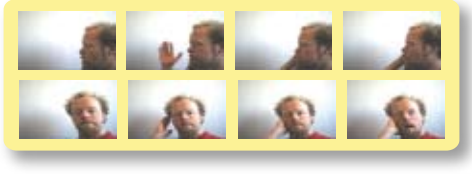
When the player arrives at the opponent's circus tent, he turns his hand until the palm off his hand is facing up and opens it. This way he can open his hand to pick up tent parts without releasing the animal. The same scooping gesture can be made to pick up dropped tent parts, running at full speed.

switch animal



When two players meet they can exchange animals by letting their controllers touch while shaking hands.

talk to teammates



Teammates can talk to each other by holding their hand to their ear. This gesture resembles making a call on a mobile phone. Using the physical interaction of both devices in a gesture emphasizes the fact that they make up one device. This should also be clear from the form factors of both devices.

6.3 design and interaction requirements:

Analyzing 'Captivate the crowd' has produced a list of design and interaction requirements to further develop the hand controller and headphones that make up the duo-device concept.

the duo-device concept

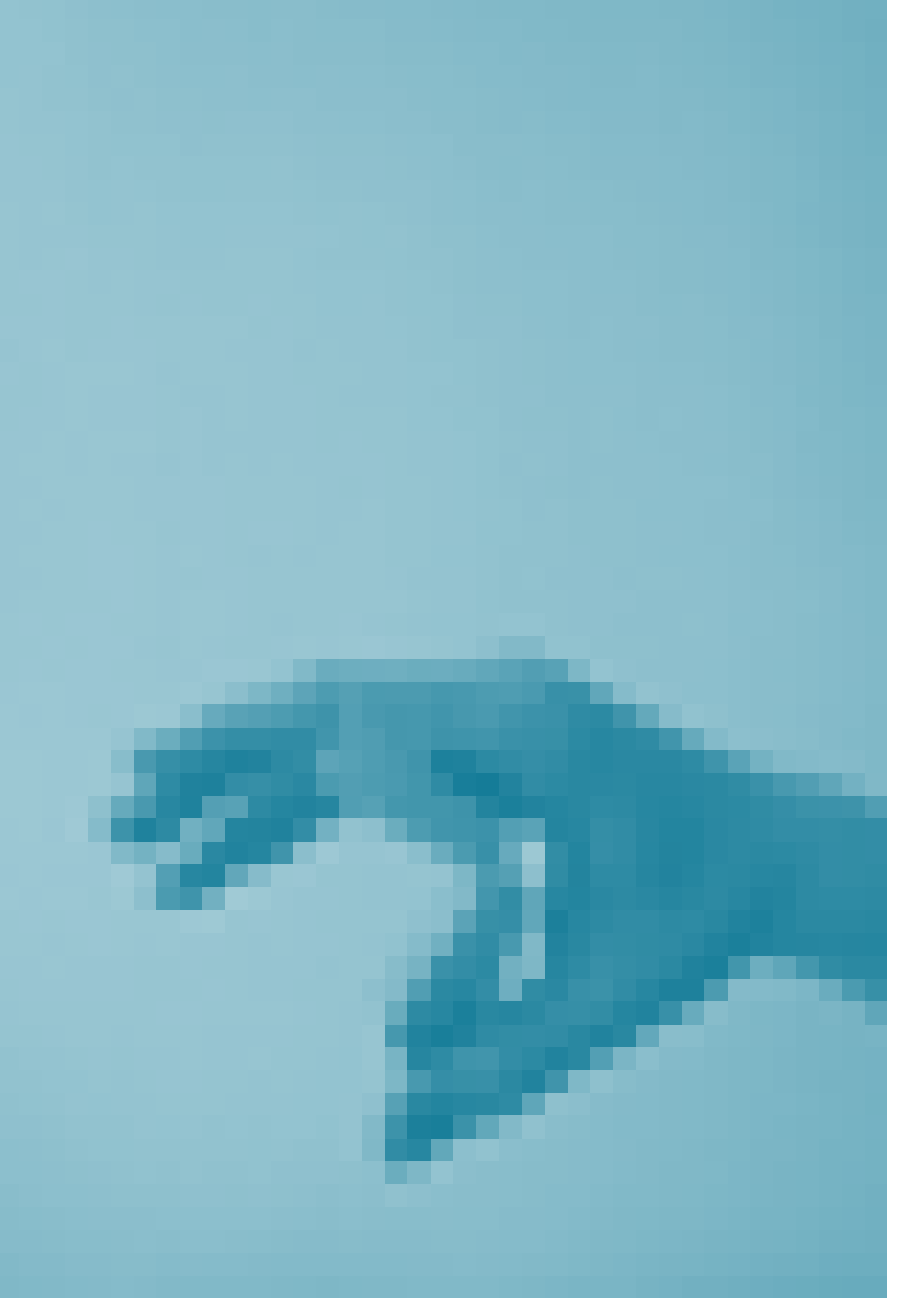
+ is comfortable to carry and interact with while running
+ can sense the gestures that trigger the actions generic to running LBGs
+ guides the players in making these gestures
+ acts as one in interaction as well as look and feel: the headphones and hand controller clearly belong together
+ has a playful interaction
+ looks and feels robust and playful
+ can be used by most adults
+ is able to communicate with a network
+ provides 'precise' location sensing (using GPS, gyroscopic compass and accelerometers)

the hand controller

+ is comfortable to wear while running
+ is shaped/behaves in such a way that it entices the player to play with it even when it is not used for a game
+ is ergonomically pleasing to most adults: hand and finger sizes, left/right handedness

the headphones

+ provide 3D audio through stereo sound and sensing head orientation
+ is comfortable while running and therefore of the 'behind the head'-type



7. duo-device evolution

This part of the design phase will show the evolution of the duo-device from a set of requirements for a hand controller and headphones to a product and interaction concept called ‘neXus’ (see chapter 8). The duo-device concept evolution that led to the ‘neXus’ will be presented into four parts.

Paragraph 7.1 sees the development of a dynamic hand controller interaction concept that guides and senses the given gestures with a playful interaction.

Paragraph 7.2 proves this concept is technically as well as ergonomically feasible.

Paragraph 7.3 turns the attention to the form factors of the (at this stage still basic shape of the) controller. Together with the headphones a duo-device emerges that looks and acts playful and robust.

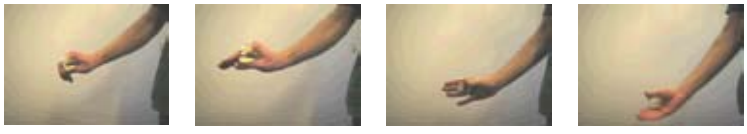
Paragraph 7.4 evaluates the concept as a generic running LBG device and makes the final changes before the ‘neXus’ emerges.

7.1 interaction concept development

In developing ideas for the hand controller it soon became apparent that using just sketches would not provide insight into important aspects of the designs, like the way a design feels while running and acts when making gestures. That is why from this early moment in the evolution, extensive use was made of low-fidelity prototypes made of cardboard, tape, elastic bands and MDF. Video recordings were used to analyze the behaviour of these prototypes while making gestures.

first prototypes

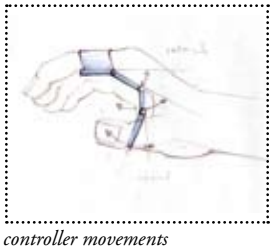
The first prototypes explored several configurations of a controller that is worn on one of three fingers and uses these two (middle and index) fingers and the thumb to guide and sense all 'Captivate the crowd' gestures.



stills from gesture with prototypes movie

guiding and sensing gestures

By limiting the movement of the one finger worn controller to just one plane of movement (see drawing) the player is guided in the most important ways of manipulating the virtual world by opening and closing the controller.

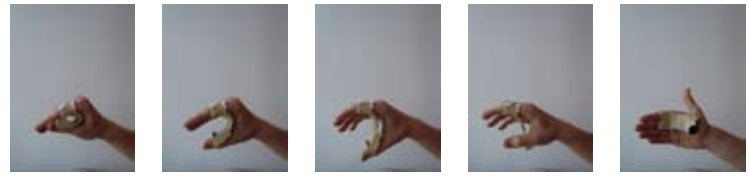


controller movements

All gestures besides ‘place top’, ‘switch animal’ and ‘talking to teammates’ are a combination of the orientation of the hand and opening it. This way the controller guides these gestures. At the same time it makes sensing these gestures relatively easy from a technology perspective. It needs to sense if the controller is open and its orientation. Whether it is the top facing up, down or side ways.
When the player opens his hand, his fingers and thumb do not hold the controller. The controller opens itself to be in the right position to exchange animals or talk to team mates. The controller notices when this happens, by sensing whether the controller is open or closed and whether it is touching another device.

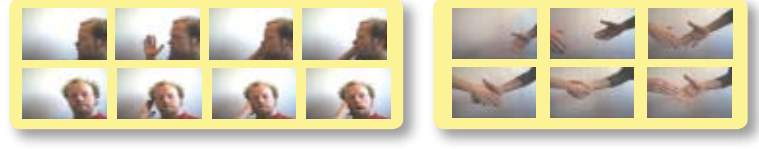
dynamic and playful interaction

The automatic opening of the controller helps in guiding the ‘talk to team mates’ and ‘exchange animal’ gestures but also makes the controller dynamic and playful. The controller seams to have a life of it’s own, even when no game is played. A player feels it tries to push his hand open, when holding it between thumb and fingers. This force coming from the controller was remarked as a very pleasant feeling by many people who wore this and later versions of the controller.
At the same time this dynamic behaviour helps to guide certain gestures. During ‘Captivate the crowd’ the controller will turn to the fully opened position when a player lets it slip from between his thumb and fingers. In this position it is ready to allow the player to ‘talk to teammates’, or ‘exchange animals’ with a teammate.



stretching controller

In order to talk to teammates, the stretched controller can now be placed against the headphone. When the devices meet up, the controller and the headphones and this opens up the communication channel. A friendly handshake, during which the open controllers touch, is enough to exchange animals.



‘talk to teammates’ and ‘exchange’ gestures

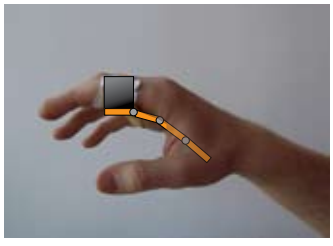
The force with which the controller pushes can vary. When the animal has spotted another

animal for instance it will push harder to be released. A slight relaxation of the hand is enough in this case for the animal to charge.
In the final iteration before the neXus appears, an additional gesture and interaction will be added that makes the hand controller even more playful, both during and in between games.

comfortable to carry while running

By keeping the controller relatively small it can easily be carried while running. But a too small controller could lead to precise finger gestures instead of combined hand/arm gestures. Looking at the 'scan, point and release' gesture it became apparent that people during this gesture touch either their index or middle finger with their thumb.
If the controller would force the thumb and these two fingers to move with the gestures the remaining two would usually follow. The width of the controller does not even need to cover the whole width of the middle finger to do this. This way a relative small controller facilitates hand/arm gestures.

Another way of making the controller comfortable to carry is to design it in such a way that the player can move as if he is not carrying anything. This implies that the player can keep his hand in a natural, relaxed posture. To make this possible, the shape of the controller in the stretched position follows the shape of the hand in this natural posture.



hand in relaxed posture with controller

During 'Captivate the crowd' however, a player holds an animal for long periods of time. This implies that the player needs to hold the controller in his fist for large parts of the game. To make this more comfortable the controller can be locked by pressing a button to stay in the closed position.

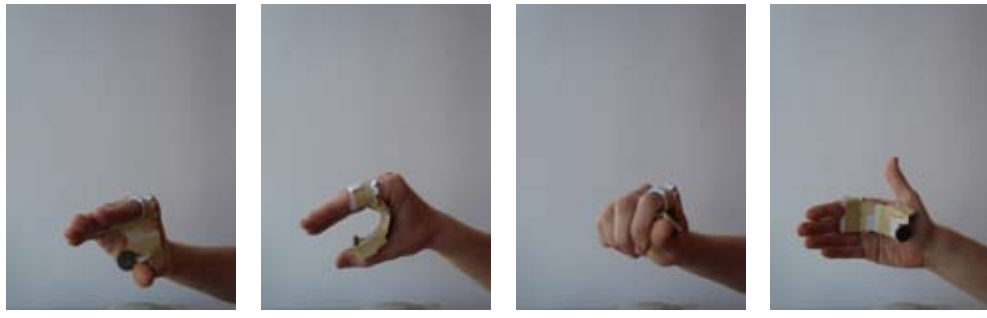
controller locked in closed position

By locking the controller, it is clear to the player the animal cannot escape and the player can return his hand to the relaxed position. On spotting an opponent he presses the button to unlock the controller while holding it shut with his fingers. This way the player can comfortably run and scan while holding the animal and still have quick control over it.

wearing on one finger

Wearing the controller on just one finger gives the player the freedom to move his fingers separately and makes the controller easy adjustable to be worn by many people. An option could have been to wear it on two fingers but the controller size would need to change to cover the width of both fingers completely. This would mean separate controllers for thick and small-fingered people. The index finger was selected out of the three possible fingers, because it provides the player with the most control over the controller.

interaction prototype

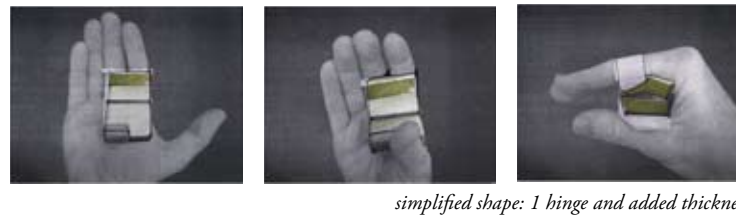


interaction prototype

The interactive prototype shows a dynamic hand controller concept that is comfortable to carry and interact with while running. Although small, the device guides the player in making playful hand/arm gestures.

7.2 ergonomic and technical feasibility

For the interaction prototype of paragraph 7.1 to be able to sense the gestures and communicate with the headphone it needs to house sensors, computing and communication electronics. This means thickness has to be added to the basic shape of the interaction



simplified shape: 1 hinge and added thickness

prototype. While sketching over photographs of the original prototype to determine the shape of the new thicker controller prototype it became apparent that, one of the two hinges could be removed.

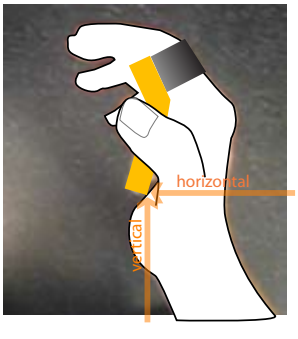
ergonomic feasibility

With a thicker and simplified shape, the basic ergonomic properties of the concept could be verified to see if the shape fitted most adults' hands. Desk research quickly showed that too many parts of the hand were involved with the controller to get useful information from anthropometric research. This form of ergonomic research indicated that there is no clear correlation between the dimensions of individual parts of the hand[1]. This made it very hard to determine the right dimensions for the controller to comfortably fit in most adults' hands from anthropometric data. Instead a small test was conducted using a MDF prototype.

MDF prototype used for ergonomicc test

Small and big-handed people were asked to put on the prototype and make a fist and release gesture. Results from this informal test:

+ People often did not understand that the controller was designed to be used between fingers and thumb when this was not told or shown to them.
+ All people could comfortably hold the controller between thumb and fingers and make a fist and release gesture.
+ People with big hands experienced difficulties in bringing the controller from the palm of their hand to between their fingers. The size of their hands made the ball of their thumb push vertically on the controller instead of horizontally.



pushing on controller

1 Wagner, Ch. (1988). The pianist's hand: anthropometry and biomechanics. Ergonomics, 31, (1), 97-131.

+ All people moved at least their index and middle finger when manipulating the controller.
+ It was often remarked that the prototype was pleasant to hold and play with.

It was decided that the design of the controller would not be changed to emphasize it can be used between fingers and thumb. Instead the controller would be presented to people in a locked position to emphasize holding it between fingers and thumb is the dominant position during running LBGs.

To overcome the problem of large handed people the shape of the controller as well as the hinge mechanism was looked at. This resulted in a new shape as well as a new hinge design.

adjusted controller shape

The controller has so far been designed for right-handed use only. A simple repositioning and enlargement of the button and the ability to position the strap on both sides of the controller makes it suitable for both right and left handed people.

Technical feasibility

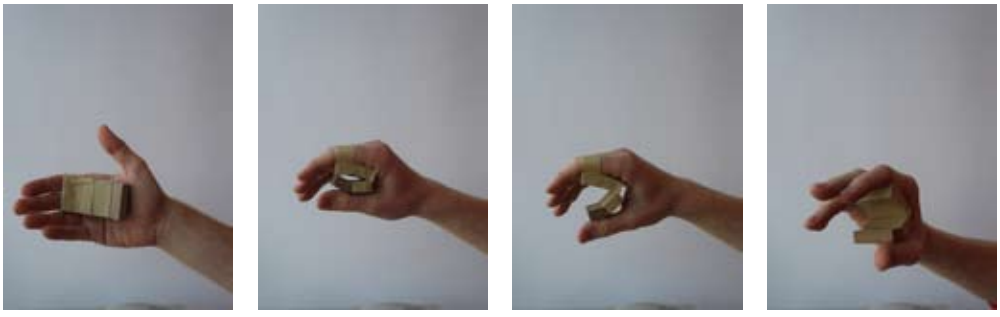
In order for the controller to be able to sense the gestures it will sense whether the device is open or closed or fully opened and sense in which orientation it is held. It will sense the direction it is pointing in with the help of a gyroscopic compass. These type of compasses[2] consist of 3 magnetometers and 3 accelerometers. Data coming from these individual sensors can also be used in the sensing of gestures. The magnetometers can be used to sense the orientation of the controller and the accelerometers provide data to sense the 'place top' gesture. In the fully opened position the touching of the aluminum insides of two controllers will sense the 'exchange of animals'. The remaining electronic components in the controller provide tactile feedback and communication with the headphones. A small motor will provide the vibration, similar to ones found mobile phones. The hand controller will communicate with the headphones using short-range communication like for instance Bluetooth.

The headphones will, due to the size available, hold the central networking parts, the location sensing and provide the sound processing in order to talk to team mates. It also will need to contain a gyroscopic compass in order to sense the orientation of the head, which is needed for the 3D audio.
All these technologies are available today and within the next five years the size of the individual components will decrease from their already small size today. This means the duo-device

2 www.sparkfun.com

concept as shown here will be comfortably technically feasible within the next five years.

feasibility prototype

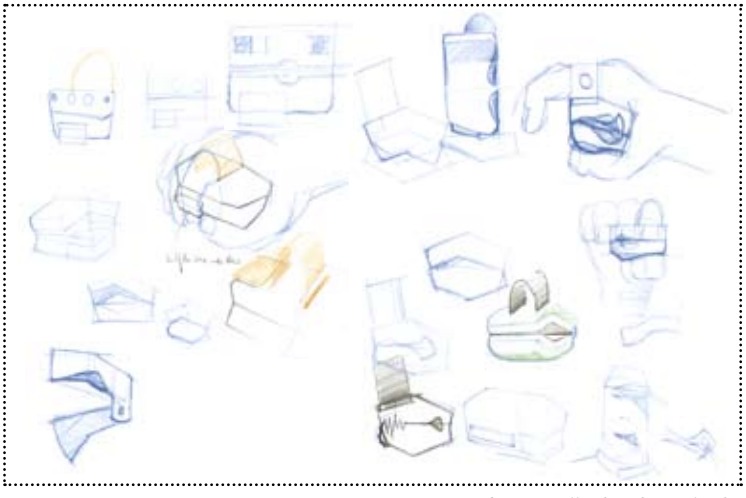


feasibility prototype

The feasibility prototype is shaped in such a way that it can hold the needed electronics and can be comfortably used by most adults. The controller acts playful and guides and senses all 'Captivate the crowd' gestures.

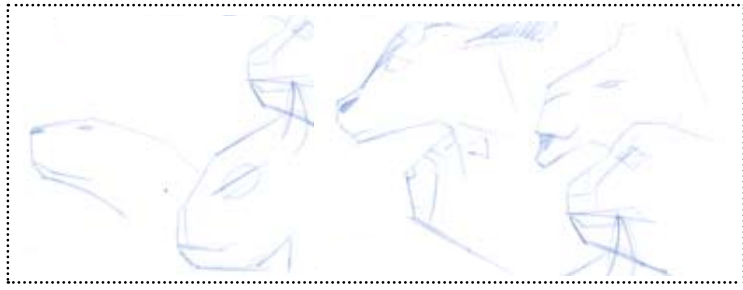
7.3 form factors

The next big step in the evolution was the refinement of the basic shape of the feasibility prototype. The aim was to find playful form factors to make the controller look as playful as it acted. The overall shape of the feasibility prototype looks fine in stretched position, but when

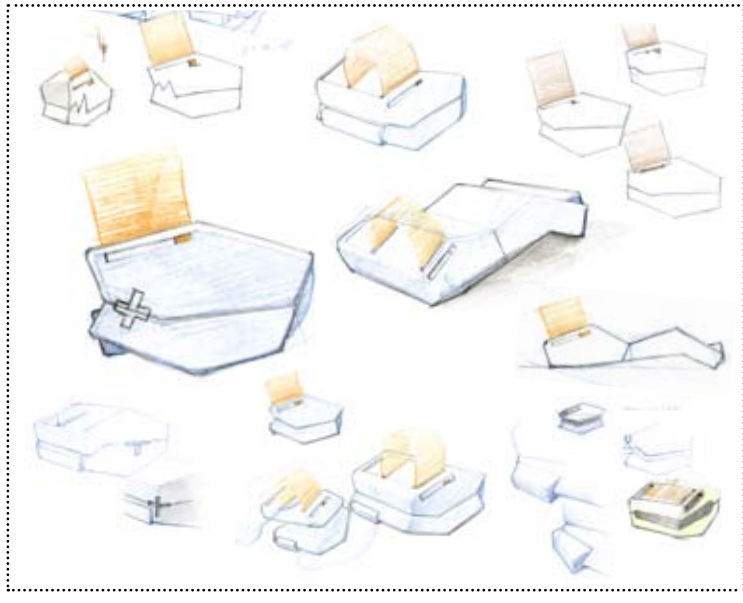


first controller formfactor sketches

closed the opening between the two halves does not look right (see sideview feasibility prototype). First explorations in giving the controller more character improved the looks, but major inspiration came from the shape of animal heads. The controller literally got more character.



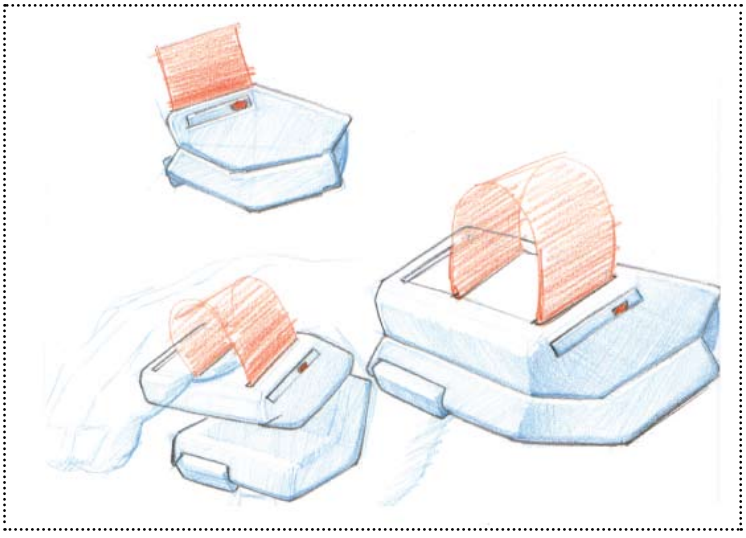
animal head sketches



'animal head' controllers

The difficulty in finding the right shape is making sure it has the right looks in both the closed position and fully stretched position. In both positions the overall shape needs to look like it could have been designed to be only in that position. In closed position it is important the controller looks right when held in the hand. This concerns mainly the side and front view of the controller. In the stretched position the inside needs to look right while the outside still needs to follow the shape of the hand in a relaxed posture. Another concern involved in the

search for the right controller shape is the shape of the headphones. In order to guide the ‘talk to team mates’ gesture it was decided that the part where the controller touches the headphones would follow the shape of the controller. This means that with every change to the shape of the inside of the controller, the headphone design needed to be altered. The inspiration of the animal heads let to a closing of the gap between the two halves. The right adjustments to the backside of the controller made sure the opened controller looked right and still fitted comfortably in the hand.



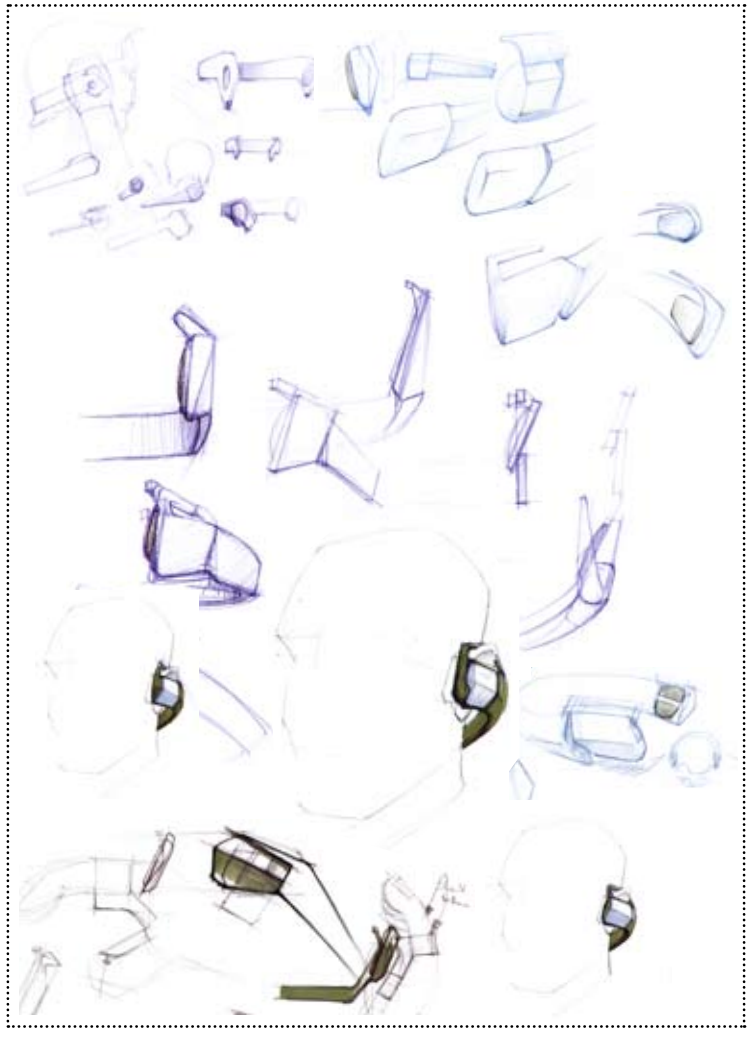
final controller design

The overall headphones design started from existing behind the head type earphones. These headphones are designed to be as small and light as possible while staying firmly placed on the ears of the runner. The headband sits in the neck while running and pushes the earmuffs on the ears to stay in place. Small straps behind the ears keep the earphones from moving up and down. To keep the weight to a minimum the headband is often kept as thin as possible.

exploration speedy looking headphones

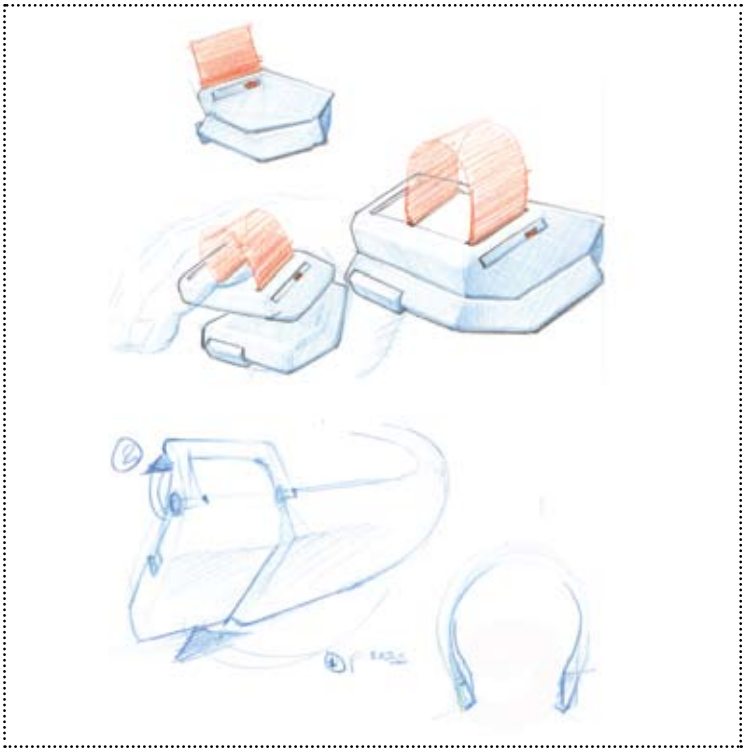
But just like with the hand controller, the headphones need increased thickness in order to

house the necessary electronics. They can still remain comfortable while running but adding thickness makes them look bulkier and therefore look less suited for running. By making the part covering the ears stand out from the headband and pointing forward when worn, the headphones housing all electronics look speedy.



form factor headphones sketches

final duo–device concept



final duo-device concept

After many iterations on the controller and headphone design, the final duo-device concept facilitates all given gestures in a playful way and looks playful and speedy as well.

7.4 evaluation of duo-device concept as generic runningLBG device

Now all actions from Captivate the crowd are triggered by the duo-device through suitable gestures, it needs to be verified that these actions encompass all generic to running LBGs. The first step in this process is to translate all the 'Captivate the crowd' actions to their generic counterparts. The second step is to look for additional generic running LBG actions. For this, the large collection of LBG ideas developed throughout this project will be used. Any additional actions found will also need to be triggered by the duo-device through suitable gestures. And again the duo-device needs to guide as well as sense these new gestures.

translation to generic

As stated before, the virtual part of LBGs consists of the following elements: objects, char-

acters, avatars and areas. These can be either static or moving. A running LBG player can potentially locate these elements, navigate to them and manipulate them. Most games will put limitations on the ability of a player to do so, but the device should facilitate all these actions. In the list shown below the 'Captivate the crowd' actions that manipulate the virtual elements are translated to their generic counterparts.

Catch animal - catch moving virtual object or character
Hold animal - carry virtual object or character
Point animal, Let go of animal - send moving virtual object or character (in selected direction)
Scan via animal - locate virtual object or character by hand controller
Pick up tent parts - pick up static virtual object or character

Place tent – mark location or place virtual object or character
Switch animal - exchange virtual object or character
Talk to teammates – networked communication with set group in game

additional generic actions

During the project a large collection of running LBG ideas was developed. The workshop on movement in LBGs (appendix C) and a brainstorm session on running LBG concepts provided the building blocks of what ultimately became 'Race anywhere' and 'Captivate the crowd'. Many interesting ideas that were not developed further were used to look for additional generic running LBG actions. This resulted in four additional generic actions:

+ carry multiple virtual objects and/or characters – In several running LBG ideas players picked up and carried multiple different virtual objects while running.
+ select virtual objects, characters carried – the hand controller is designed to manipulate one item at a time. So when a player carries multiple different virtual objects he needs to be able to select the one he wants to manipulate.
+ mark location at a distance – Several games use 'throwing' virtual objects to mark locations at a distance. The stronger the throw gesture, the further the object will be thrown.
+ mark/set area – besides marking a location, some games, or setting up games use marking an area as well as a location.

final list of generic actions

The final result is a list of all the generic running LBG actions that need to be facilitated by a generic running LBG device. The duo-device concept triggers the actions that involve manipulating the virtual world by gestures.

carry virtual object(s) and characters
select virtual objects, characters carried
exchange virtual objects, characters

locate static virtual objects, characters
navigate to static virtual objects, characters
pick up static virtual object, character

drop/place static virtual object, character

locate moving virtual objects, characters
navigate to/ follow moving virtual objects, characters
catch moving virtual object, character
send moving virtual object, character (in selected direction)

mark location/place virtual static object
mark location at a distance

locate area
mark/set area
enter area
leave area

exchange object
networked communication in game

additional gesture and duo-device adjustment

The final development of gestures and the duo-device was carried out simultaneously. Adding gestures to trigger the additional generic actions completed the overall collection of gestures. At the same time the duo-device was adjusted to guide and sense all gestures.

carrying and selecting from multiple virtual objects

When a player picks up multiple virtual elements, the controller holds the last one to be picked up. The player also carries the other elements, but he can only hold one element using the controller at any given time. When the player wants to for instance throw a different element than the one he is holding he needs to switch between elements.

selecting from multiple virtual objects gesture

The final design lets the player open the controller to the 'neutral' position also used for talking to teammates and exchanging objects. When in this position the player can quickly spin the controller in his hand.
With every full turn of the controller a new element is selected. A gentle movement will make it spin once and go to the next element. If the same movement is repeated, the controller picks up speed and the elements quickly pass through the players' hand. Hearing the element he needs, he grabs the controller and stops the spinning.

mark location at a distance gesture

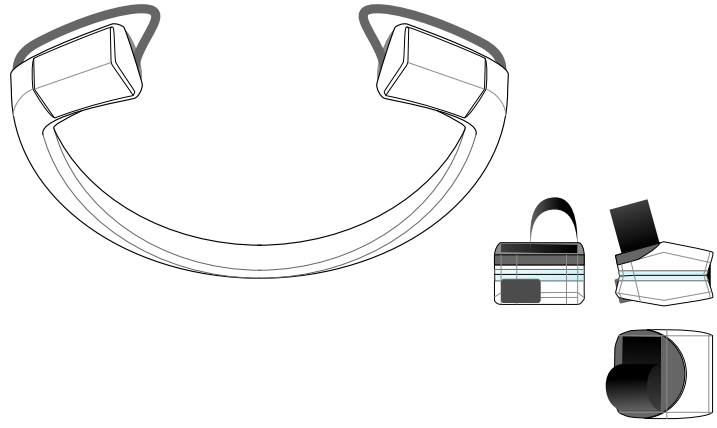
A throwing gesture is used to mark a location at a distance. The accelerometer present in the hand controller to help with the orientation sensing can be used to sense a throwing gesture when the device is orientated the same way as when marking a location.

mark area

Areas can be marked by leaving the controller open in the same orientation as the end of the 'mark location' gesture while moving round.

generic form factors

The form-factors had to be changed to allow for the integration of the spinning functionality. This opportunity was used to give the overall duo-device concept a more generic look, which would fit in with all running LBGs. The animal features remained only subtly.



generic duo-device form factor adjustments

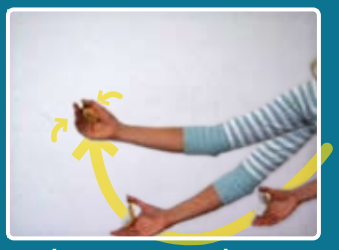
final design: the neXus duo device

Now all actions generic to running LBGs are triggered by playful gestural interaction, by a playful but sturdy looking duo-device, the product and interaction concept is completed. It will be named the neXus to indicate it forms the nexus between the virtual and physical parts of the location based gaming world.

8. the neXus duo-device

hp

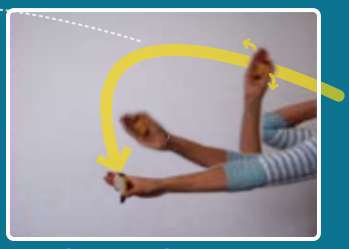
nexus hp



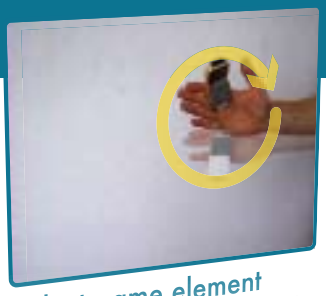
pick up game element!

catch game element!

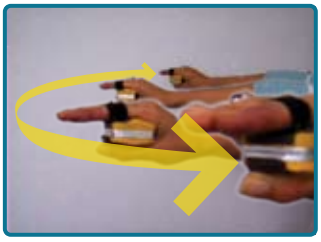
mark location!



mark at a distance!



select game element



locate game elements

send game character

exchange elements

talk to team mates

the duo-device that turns your city into a mixed reality playground

www.pieterdiepenmaat.nl/nexus

9. conclusion

conclusions

This project has shown the development of a dedicated mediascape device based on a thorough understanding of future mediascape experiences. The development took place both from a user centred and technological perspective. Technological developments will lead to more dynamic mediascapes, but although technological developments will improve location sensing, a substantial uncertainty and scale difference will still exist in mediascapes within the next 5 years.

Within this project a dedicated mediascape device has been developed that will facilitate the visitor in navigating and manipulating the virtual part of a mediascape while keeping the freedom to move in the physical world. By developing running location based games on the basis of the technological possibilities and limitations this freedom of movement has been explored in a variety of ways. Overall, the project demonstrates that an interesting mixed reality can be made possible between a virtual and a physical world. The mediascape developed in this project, together with the dedicated device, have shown the potential of experiencing such mixed realities.

Within the project the decision has been made to design a mediascape device for only a limited number of mediascapes. In order to be an integral part of mediascape experiences, a dedicated mediascape device can facilitate only one genre out of the large collection of mediascapes that will exist within the next 5 years. Each genre consists of mediascape experiences with similar interaction models. An interaction model describes what the visitor needs to do to experience a particular mediascape to the fullest.

The selected example genre of location based games exploits the potential of mediascapes in providing new ways of experiencing media through movement. The particular focus on running location based games made it possible to explore the gestures and movements needed to design for the selected interaction model. The decision to develop two new game concepts for running LBGs further aided the process of discovering solutions for a gestural-based interaction.

However, there still is a need for optimization of groups with similar interaction model , i.e. the different genres. As this project has showed, dedicated mediascape devices work best when they are designed for only one specific interaction model, or genre.

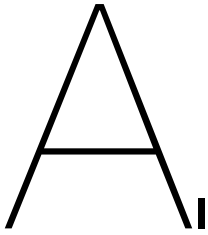
recommendations

In order to be able to evaluate the design, a user test, involving a working prototype should be conducted. Ideally this would consist of playing a running LBG using the a prototype of the dedicated mediascape design. This would call for a prototype that uses precise location of a running player as well as the orientation of his head and hand. Due to the time consuming nature of setting up such a test this could not b e achieved within the timeframe of this project.

However, during the design process, various users have been aiding the design process by evaluating and testing the different low-key prototypes. Responses indicate that the device allows enough freedom of movement to ensure a pleasurable gestural-based interaction. Also, a re-enactment of the final game concept “Captivate the Crowd” took place in the final stages of this project. This yielded positive responses on both the game itself, as well as the interaction with the device during the game.

This project has demonstrated that the potential of gestural-based and movement-based types of interaction in the area of location aware computing are promising. Therefore, one final recommendation concerns the further development of location based games. These location based games will be appropriate vehicles to explore the possibilities of new and innovative types of interacting with location sensing technology and experiencing mediascapes.

appendices



Personal experiences of mobile Bristol projects

Riot! 1831

'Imagine a play for voices. It is the Bristol Riots of 1831. The Political Reform Bill has been defeated in Parliament and the vote denied once more to ordinary people. Now those people are rising up and thousands of them have filled Queen Square in the heart of the city to vent their fury. You hear the rioters' voices as they plunder the surrounding buildings, the flames as buildings burn, the merchants as they flee for their lives and the Dragoon Guards as they sabre-charge through the crowds cutting the rioters down.'
http://www.mobilebristol.com/flash.html

I started this mediascape in the middle of the square next to the statue of King William II. I heard people talking and shouting in the background and when I walked round the statue a man began to sing…..

Things I liked:

The overall experience was good in setting an atmosphere. I did not get the feeling I had to listen to all the conversations to make sense of it all. If a conversation was not particularly interesting you could just walk on and bump into the next one.
Walking around just listening by headphones without having to hold the PDA was a liberating chance from the TATE modern tour.
The build-up to the charge was very suitable, because it reflected the chaotic situation on and just of the square. Until the actual charge you kept on hearing conflicting orders given and people debating if they would charge or not.
The man singing was a very nice touch, especially when he returned just after the Dragoon Guards charge. It felt like a narrator/bard telling you the feelings of the people.

Things I did not like:

I toughed I would be able to navigate wit my feet, in the sense that I could hear a conversation becoming louder if I walked towards it and softer when walking away. This did not happen. In fact, it felt like I was walking round the square blindfolded and bumping into things with my feet. I had to stand still to pick it up and examine it further. When I moved while examining it, it would often fall out of my hands back to the ground. Sometimes I found it again and continued examining it but most of the times I could not retrieve it.
The location specific sounds were mostly conversations between people. They were mostly character driven and had no connection to square as I saw it (except for the statue). This made me feel I did not really had to be in the square to experience this mediascape.
After walking across the square for some time listening to many conversations, the Dragoon Guards charged. This was a real focus point of the experience so far. In the conversation beforehand there was much speculation and debate on whether they would charge or not. The only problem was that after the charge scene the conversations were still speculating if they would charge or not. Time wise this did not really make sense.
A couple of times I heard two conversations simultaneously, which made it really hard to understand either one. It was not clear to me if this was done on purpose, to express the chaos on the square, or that it was a technical error.

Moulinex – by Zoe Irvine

'This piece takes as its points of departure the filmic sensation of using a walkman and Queen Square's recent history as a venue for open air cinema screenings. The viewer of the work navigates the physical landscape in which there are lingering fragments of film soundtracks which have both been shown there; the Matrix and Moulin Rouge. As the viewer/listener first walks around the soundscape it takes the form of an auditory archaeological dig but as the viewer moves further the sounds begin to merge and transform taking on ideas of DJ culture and plunderphonics.'
http://www.mobilebristol.com/flash.html?http://www.mobilebristol.com/arnolfini.html

I did not have the feeling I had any influence on the sound. It could have been that I was listening to a pre-recorded piece of music. I tried walking back and forward on the same line, but even then I could not find a relation between my movements and the sound I was hearing.

A description of this place as if you were someone else – by Daniel Belasco Rogers

'As you walk down a street, do you wonder if it can remember everything that happened on it? Can bricks and mortar really record sound vibrations from the past and if so would you be able to hear yourself? A description of this place as if you were someone else is an exploration into siting personal histories in geographical locations such as Queen Square, to form the tapestry of experience, and how the viewer can use the technology to peel back the city's layers, revealing those personal stories of first kisses and car crashes.'

I just experienced this for a minute or two and hope to experience it some more. I really like the fact that it strongly refers to the square as you see it.

B.

Notes on: 'Mobilising the Museum Experience'

Workshop at King's College London, 27 April 2005

‘Introducing ArtStart - developing a world-class interactive for the National Gallery’

Steve Dale & Philip Read (National Gallery & Nykris) Steve.Dale@ng-london.org.uk

ArtStart

ArtStart is a very beautiful touch screen based information system on the complete collection of the National Gallery. It is as such not an example of a mobile museum experience but it aims ‘to enhance the visitor experience by offering a stimulating and modern way to discover the Gallery’s renowned collection of European paintings.’ The same can be said for most of the mobile museum experiences. Find more information about the design of ArtStart on this website.

Location inside the National Gallery

The National Gallery chose to use a static system outside the rooms showing the collection rather than a static system inside the rooms or even a mobile system. Although there are good examples of making mobile systems work (the omnipresent audio tours or the multimedia tour at TATE modern) the senior management of the NG feels allowing multimedia information systems into the rooms will interfere with the experience between a visitor and the works of art. This mainly concerns other people using those systems while you are enjoying the art. There is research done at the Victoria and Albert Museum which contradicts this. You can the article on this research here.

‘Adventures in mobile pictures: A National Gallery project ‘

Charlotte Sexton (National Gallery) Charlotte.Sexton@ng-london.org.uk

Pictures on your mobile

This is another project from the National Gallery, but compared to ArtStart this is much more an experiment. The website of the NG allows you since 2003 to send pictures and ‘tombstone information’ of pieces of art from their collection to your mobile phone. You can also send general information on the NG, like opening hours, to your phone. The NG will not charge you for the information or the picture but your network provider will charge you for sending the picture to the phone.

Usability

There are many usability issues that need to be solved to provide the user (in or outside the museum) with a quick way to get the pictures on his mobile. The main problems are the usability of receiving pictures on your phone in general and the usability of the current website. One solution would be to provide a physical link to the picture inside the gallery, with a QR barcode for example. Find out more information on this here.

Research:

5000 downloaded images over the 2 years, 350 times the general info
Sunflowers by far most popular but marketing for major exhibition had big influence on popularity other works

Research needs to be done on who uses this and what for? Memento or just nice background picture

‘Tate Modern Multimedia Tour: From Pilot to Product’

Gillian Wilson , Jane Burton (Tate Burton) Gillian.Wilson@tate.org.uk Jane.burton@tate.org.uk

Extensive information on this project can be found on this part of the Tate website.

Personal experience of the tour 28-4-2005:

Things I liked:

The labelling of the different media on a specific work of art;
After selecting a specific work of art most times it was clear I was not interested in all media available on that work. I could easily pick out the ones I toughed most interesting. By starting my tour going through all of them I noticed this first impression was right.
Previewing the next rooms;
Several times I had a peek at the multimedia tour information available on the works of art in the next 4 or 5 rooms before entering them.
The overall look and feel of the tour;
I enjoyed the clear graphical style, the calmness of the interaction and the voices used in the tour.
The little bubble-animation indicating the current audio has not finished yet.

Things I did not like:

Carrying the PDA on a thin cord round my neck;
this made the PDA dangle just below my belly which was made even more uncomfortable by the thin cord round my neck. I tried shortening the cord but this mend I had to hold the PDA up to high to my face to be comfortable. I ended up carrying the PDA in the inside pocket of my jacket while wearing the cord round my neck. This was much more comfortable, but it sometimes triggered the touch screen causing the tour start on its own.
The audio feedback
Although I liked the overall look and feel of the deign, I think the sounds that are used to give feedback when you press a button are a bit to ‘clunky’ and at least to loud compared to the voices.
Not receiving the information I asked for.
There was an option to receive more information by e-mail on the works of art featured in the tour. It’s now almost a week after the tour and I still have not received it.

To bad the locating awareness originally designed into the tour did not work.

"Using 21st Century Technology to learn about 17th Century Art"

Ellie Burkett (Warren Comprehensive School) EBurkett@warren.bardaglea.org.uk

This was the real highlight of the colloquium. Unlike the other project this one was consumer led, by Warren Comprehensive School, instead of gallery lead. This meant that there was great knowledge of the users in the project from the start. These users were students who were not used to going to musea or galleries. The other big advantage was that this project could be easily incorporated into the existing teaching methods. The final design consisted of an interactive 'trail' round the gallery during which the students were encouraged to record their experiences. Back in the classroom this record was used to relive the trail and inspire drawings as well as essays. You can find more info on this website.

Outcome:

Trails encouraged students to collaborate.
Remarkable reactions from the students (some students even went to other galleries on their own after going on a 'trail', this had never happened before)
Improvement in analytical and practical work

Reasons this project worked so well:

Clear (educational) objectives from the start.
Great end-user knowledge from the start
Possibility to fully incorporate project into existing teaching methods.
Trails could be easily made and edited by the teachers.
The trails are private and can be shared at the same time. The students all had their own PDA and were addressed by their first name. During the trail questions were asked on the works of art in the gallery. Students using the PDA felt free to make mistakes without being embarrassed within a group. This increased their confidence and in turn made them ask more interesting questions at the end of the tour. During the trail the students helped each other with the assignments.

'Learning for the future: What the RI found for its development programme using PDAs'

Prof Frank James & Olympia Brown (Royal Institution) OBrown@ri.ac.uk

The royal institution's first try at providing a PDA based tour was, like the title says, mostly a learning experience. Besides providing an engaging educational location aware tour of the collection, it tried to clear the unfamiliarity of the public with the RI and its collection. In doing so the RI found the following problems:

+ As with other musea the internal locating technology did not work.
+ It was unclear to the public if the tour was designed as a learning or an entertaining experience, due to the publics unfamiliarity with the RI as an institution as a building and its collection.

'Involving and Evolving: 'A reconceptualisation of the guided tour"'

Dan Sutch (Nesta FutureLab) Dan.Sutch@nestafuturelab.org

What makes the 'Mudlarking in Deptford' tour special is that it is largely made up of past and present visitor experiences part of the tour. The visitors become co-designers of the tour.

More information on this project can be found on this part of the NESTA Futurelab website. Or download a PDF.

"Museum practitioner's aspirations for mobile technologies"

Ben Gammon (Science Museum) B.gammon@nmsi.ac.uk

Ben Gammon presented what he, as a senior manager of a large museum, wanted from new mobile technology, regardless of whether it was feasible or not. This list of criteria showed a great insight into the wants, wishes and problems surrounding new technology from a museums point of view.

I hope I will be able to obtain a copy of his presentation and present it here.

Overall conclusions

Navigation/locating

Musea, almost without exception, have problems in helping the visitor navigate through the museum. Many people have problems with maps. Location aware devices seem the perfect solution, but every (indoor) museum trying to include a location aware navigation system in their multimedia tours had to abandon this. The indoor locating technology does not seem to be up to it.

Future of mobile devices

At the moment musea and their technological partners, like Antenna-audio, rely on PDAs for their multimedia tours. In the future, it is expected that most people will carry their own device with them that have the same or probably better capabilities. The first step in that direction could be the 3G phone. This would mean the musea don't have to invest in expensive hard-ware but have to keep an eye out for those portable technologies (which will be) used by a large part of the public to access multimedia. At the moment the mobile network providers combined with the phone manufacturers are pushing a wave of new technologies but it's unclear which, if any, will become the standard.

Low visitor take up

Although this is based solely on the experiences of the Tate multimedia tour, these are the reasons they found for the low visitor take up of this tour:

+ Limited marketing
+ Visitors still unfamiliar with multimedia tour compared with the audio tour
+ Price; a multimedia tour costs £3,50

Potential PDA tour

Just like the physical part of the museum, these virtual tours are not about showing the visitor all the knowledge and objects the museum possesses. The PDA-tour's power lies in the ability to let the visitor interact with information on their individual level about they find interesting of the things physically around them.

Confidence

It is very important that the visitor feels confident about using the technology if you want him to fully engage in the experience. Ease of use from the start is a major factor but encouraging the visitor to take his engagement one step further when has reached a certain level of confidence leads to an even deeper experience.

After visit experience

The impact of a PDA tour is greatly increased by encouraging the visitor to adding after visit connection. In its most simple form this could mean sending an email to the visitor after the visit. It would contain information the visitor indicates he was interested in during the tour. A technically more complicated way, but very effective nonetheless, is encouraging the visitor to record their experiences during the tour and revisiting them. In the case of Warren Comprehensive School this was used to relive the visit but in the Mudlarking project (Nesta Futurelab) the combined experiences were a major part of the tour.

Expectations visitors

The expectations visitors have of PDA based guides are largely unclear. The one thing that is clear is that when a part of the museum collecting is virtually augmented, they expect everything to be augmented.

Visitor research

The musea and researchers would like to have some kind of laboratory setting to test ways of providing the public with information. This is partly to test what works and does not work, but more importantly to find out why. Research on this subject has been absent for a long time. There is no knowledge, for example, whether the written information labels used in virtually any museum, provide the visitor with the learning experience they were designed for. This makes judging new ways of providing information even more difficult.

Screen size

Some tests showed a need for a slightly bigger screen to be able to show more information. But the projects most successful in engaging the visitors (Tate, Warren Comprehensive School and Mudlarking) never had this problem.

Group behaviour

Although several projects mentioned the use of the PDAs in groups, none had a clear view of the way they used it and the effect it had on group dynamics. All tours were designed to be used individually.

C.

Workshop ‘movement in location based gaming’

18-7-2005 Rotterdam

This workshop was an experiment in using a design method developed by Sietske Klooster called ‘designmovement’ to location based gaming ideas. Location based games, like all mediascapes experiences, use moving around as the most important way of interacting with the mediascape. But all other interaction in existing mediascapes is focussed on small screen based portable devices. To free this project from the screen based interaction, I wanted to explore ideas by starting from movement. Designmovement sees designing products as designing the ‘choreography of interaction’. It creates these choreographies by physically exploring the movement of the body with the product and the surroundings. This is a fitting way to explore ways to physically interacting with products.

Until now designmovement has mostly been used to design tangible non-intelligent products. This has led to intriguing designs (TU Eindhoven website). Besides this workshop explored ideas for location based gaming, it was the first time designmovement was used to design intelligent products. It was therefore an (informative) experiment on both sides.

After an introduction on LBGs I explained that I would like to have provided them with a selected LBG-type which they could explore through movement to generate ideas the appliance. But since the game type was not clear, the workshop explored the concept of LBGs inspired by the physical location where it took place; Noordereiland in Rotterdam. After introducing the subject, Sietske Klooster explained that we would explore it by movement, creating ‘choreography of interaction’.

This document will not provide an exact description of what happened during the workshop. For further information on ‘designmovement’, please contact Sietske Klooster (Sietske@designmovement.nl).

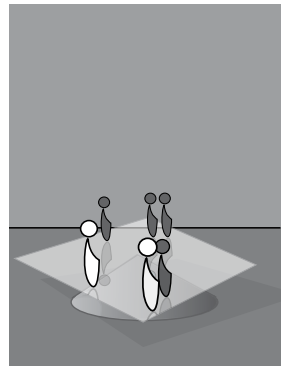
Results

The workshop resulted in 3 game ideas (of which 2 we played) and a series of conclusions.

Game 1 – balance

Game in physical world

Two teams compete on a surface to bring it in balance or imbalance. The teams are both the same ‘weight’. So if all 4 team members of ‘team Balance’ stand at one end of the surface and the 2 members of ‘team Imbalance’ at the opposite end the surface is said to be in balance. Every player envisioned that the surface was supported in the middle of the surface by a cone (see figure). Team Imbalance has fewer members because if they had as many members and used the right tactics they would always win. When we played the game there was usually a general consensus if the surface was in balance or imbalance and this was shouted by the ‘winning’ team at that moment. So if the surface was in balance ‘team Balance’ would shout ‘balance, it’s in balance!’



Ideas

It was clear that this game could be greatly improved by the introduction of a virtual layer. This layer would calculate the imbalance and feed this information back to the players. Most product ideas explored how this feedback took place.

Put loud speakers on each corner of the virtual balance and use changes in pitch and direction to indicate direction and amount of tilt.
Lights on the ground indicate imbalance and tilt.
Soles of the players' shoes indicate the amount of imbalance, but not the direction. Players must find this by moving around.
Players wear a crinoline which tilts to indicate amount and direction of imbalance.
Players' virtual weight is not located at the centre of the player but worn around the wrist. This makes quick shifting of weight over short distances possible without having to move around.

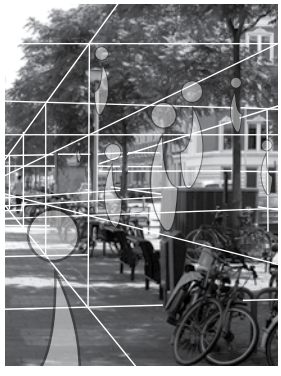
Game 2 – photo hide and seek

We played a game of hide and seek, using the whole island as a playing field. The objective for each player was to try to photograph as many players as possible while trying to not be photographed.

Ideas

The players liked playing this game more than the balance game, but they could not find real improvement by adding a virtual layer to this game. Most ideas focussed on improving the player's ability to find other players.
Ideas
Each team has a tactician, who monitors all the players' movements, the incoming pictures. He can communicate with his team mates and guide them to the opponents.
The player's device could sense another player was near without indicating a direction.
Photos taken were send to the player who was being photographed 30 seconds after it happened.
During the game the playing field becomes smaller and smaller to make it harder to avoid each other. The device indicates when you leave the game.
Starting from the idea of literally getting to the next level, this LBG uses vertical as well as horizontal movement in the physical world. The playing field on the ground is divided into areas. Above these areas up to 3 different height levels can exist. So the virtual playing field consists of a grid dividing it into 3D spaces (see figure). By climbing on objects in the physical world and staying in such a virtual 3D space for a set amount of time it can be occupied. A team gets points for each space it occupies at the end of the game. More points are earned for more difficult spaces to reach. Of course the team with the most points at the end wins.

Game 3 – level climbing



Starting from the idea of literally getting to the next level, this LBG uses vertical as well as horizontal movement in the physical world. The playing field on the ground is divided into areas. Above these areas up to 3 different height levels can exist. So the virtual playing field consists of a grid dividing it into 3D spaces (see figure). By climbing on objects in the physical world and staying in such a virtual 3D space for a set amount of time it can be occupied. A team gets points for each space it occupies at the end of the game. More points are earned for more difficult spaces to reach. Of course the team with the most points at the end wins.

Conclusions:

+ There are two types of LBGs; one is to enhanced existing games with location sensing technology. This is very common in existing LBGs and mostly results in the device being an extra information source to the player. The attractiveness of the appliance and the interaction with it is the major reason to play a game this way.
+ Truly mixed reality games, like the 'balance' and 'level climbing' game, cannot be played without this technology, but this type of game hardly exist.
+
+ The conditions of immersion and magic moments need to be clarified further and might lead to an insight to why LBG work or don't work.
+ LBG that offer immersion and magic moments can be achieved by enhancing the senses or physical capabilities of the player or enhancing the physical environment.
+ During LBGs the player needs to be able to sense and manipulate the virtual part of the gaming world. This is the essence of what the device has to facilitate.

Possible design directions:

+ Take a specific location and design games for it. Both site specific and non-site specific games will probably appear. Market it as a digital playground, a place to meet other players who have such a device and are keen to play.
+ Instead of using technology to enhance players or environment's abilities, use it to decrease these abilities. For example; shrinking playing field with passing of time.
+ Combining all insights into the needs and aspects of LBGs might result in a description which is clear enough to be used as input for a dedicated LBGing appliance.

hp