In the dark – designing navigation for a haptic theatre experience

Conference or Workshop Item

In the Dark – Designing Navigation for a Haptic Theatre Experience

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ABSTRACT
We describe the ongoing work of a collaborative theatre project, in which blind and sighted members of an interdisciplinary team are working on the creation of an immersive and accessible theatre experience. The theatre experience is set in pitch dark, and uses audio and haptic ubiquitous technologies to guide both blind and sighted members of the audience. During two sessions which explored the use of enactive navigation in the dark space, participants were able to locate areas of interest within the dark, using enactive explorative navigation, and some participants described this as a 'dense' experience.

General Terms
Human Factors.

Keywords
Haptic navigation devices, ubicomp experiences, accessibility, blindness, immersive theatre.

1. INTRODUCTION
Mobile navigation devices are in wide use and have become part of the everyday experience for many people. In most cases these devices use the visual modality to convey spatial information in the form of maps to the user and hence cause problems for users who are visually impaired. In [1] the need to maximize the haptic and auditory channels is identified as one of the major challenges for future work in the area of geospatial navigation, along with the need to identify when users actually want more information, and to understand accessibility as something that is for 'us' and not only for 'them'.

Navigation is not unique in posing accessibility problems, and for users with visual impairments there are many areas of life in which a full engagement is denied. One such area is the dramatic theatre performance, which traditionally takes place on a stage and assumes that the audience members will 'see' the actors and the set.

We describe the work of a collaborative interdisciplinary team of both blind and sighted members working towards the creation of an immersive theatre experience [2]. This haptic theatre relocates the dramatic action within the physical experience of both visually impaired and sighted audiences, rather than at a distance on a stage. As part of this project we develop a novel sensory technology for navigation in the form of hand held, haptic devices. These devices will support both visually impaired and sighted audience members as they move through a specially designed audio and tactile environment that is in pitch darkness. The device provides information on the proximity to focal points of interest within the space, through haptic feedback, and there is no visual clue detectable by sighted or blind audience members. The device has been designed around the concept of *enactive exploration* meaning that navigational information is only uncovered through physical movement.

In the remainder of this paper we first discuss the background of creating ubicomp experiences as well as approaches developed for sensory substitution devices. Next we report on findings of two prototyping sessions in which a number of sighted and blind users explored the new navigation model. One of the questions in these sessions was precisely about whether the devices provided enough information to enable participants to confidently navigate through a dark space. Furthermore, given that in the dark both blind and sighted audience members are denied all forms of visual information, there is no 'them' and 'us', and the immersive theatre experience transcends the normal divide between blind and sighted audience members. We discuss the experience of navigating through the dark space and outline future work.

2. BACKGROUND
Ubiquitous computing applications are increasingly designed in order to enable people to express themselves and to create experiences that are emotionally meaningful [3]. We are creating an artistic experience that will be equally accessible to blind and sighted audience members using such ubiquitous technologies.

The idea of creating artistic or cultural experiences for sighted people has been explored in a number of different contexts [4,5,6]. In [4] a participant walks through a gallery which recreates a woodland experience using photographs of trees and animals and sounds of birds or leaves that go with these images.

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The sounds are associated with particular locations in the gallery, and as the participants move around, they hear different sounds through their headphones. In the Riot!1831 project [5] the experience takes place outside, in a town square in Bristol where in 1831 a violent riot took place. As participants stroll around this square, wearing head phones, they feel transported to these riotous scenes as they hear shouting, screaming and gun shots. During this experience the participant will see the very buildings that stood in this square at the time the actual riot took place. In both these experiences, the designers made use of audio to enhance the visual – that is, woodland sounds augment the photographs of woodland scenes, sounds of shouting and firing gunshots enhance the square itself, and in both cases audio only becomes available to participants if they are in the relevant zone. Both experiences were created in collaboration with artists as meaningful, memorable cultural experiences. Furthermore, in [5] the focus is on identifying so called 'magic moments', described as 'those moments which are deemed to be both moving and memorable and thus are those that people really value'[5].

A different approach was used in the ambient wood [6], designed as a learning experience for children encouraging them to conduct scientific experiments in woods and parks and to explore and discuss scientific ideas in situ. Various forms of digital information, in the form of images displayed on handheld devices or sounds, could be requested, obtained or serendipitously 'pinged' when a person was detected in the vicinity. Short range FM transmitters were set up in the woods to broadcast sounds to receivers carried by the children. Children were also given probing devices in order to collect data, which could be discussed there and then or sent over to the classroom for further discussion. Compared to the previous two experiences, the Ambient Wood created a more complex digital augmentation, and was geared towards active forms of learning and exploring.

However, all three experiences were developed for sighted participants. Furthermore, these experiences did not employ any particular navigational guidance as participants were allowed to explore the area by wandering around. This caused no problems as all participants were sighted. In the immersive theatre project participants will be both blind and sighted, and the experience will take place in pitch darkness, therefore making target location and navigation an issue for all participants.

A number of researchers have been working on sensory substitution devices for the blind, inspired by the work of Bach-y-Rita [7]. The TVSS system he developed was in the form of a chair which had hundreds of vibrating plates resting against a blind person's back, which vibrated in connection with a camera placed above the chair, looking forwards. The pattern in which the stimulation occurred enabled the user to "see" in that they were often able to recognise an object coming towards the camera. Subsequently, other sensory substitution devices have been developed including haptic devices for navigation. An example is the FeelSpace belt [8], which has vibrators that are governed by a compass. Whichever vibrator is pointing towards north is active, and is thus providing the belt wearer with geospatial information. Another example is the Enactive Torch, which, in one setting, provides the user with a continuous stream of vibro-tactile feedback to the hand, where the strength of stimulation depends on the distance to the object which is currently pointed at [9]. The torch thus allows the user to 'see' objects or obstacles that are in front of them. Important here is the notion of enactive exploration, where the user receives information only when physically and actively moving the torch. Our approach builds further on the Enactive Torch approach, by applying the concept of enactive exploration to the context of *global target location* rather than sensing the presence of local objects.

3. IMMERSIVE THEATRE

We are creating an immersive theatre experience, which makes no use of visual elements, and is deliberately set up in a dark space so that sighted and blind audiences have equal levels of sensory loss. Locations, or zones, within the dark space are associated with different strands of the script and are modeled as islands of sound, tactile set and narrative. We therefore use the haptic modality in two senses – through the set, where the audience can feel objects and backgrounds, and through the inclusion of the haptic navigation device. Audience members use this device to physically move through the dark space and thus be on a narrative journey.

3.1 SYSTEM SET UP FOR NAVIGATION

The technology developed for navigating the haptic theatre experience consists of two elements – (i) an array of beacons attached to the ceiling of the environment and (ii) handheld haptic devices that the users use to navigate through the environment.

The beacons emit digital infrared signals in a downwards cone that represent numerical data. The proximity of a beacon to a 'target location' determines the number which it transmits, where zero represents a beacon that is at a target location. The handheld haptic device contains infrared sensors (pointing at the ceiling) that receive the infrared proximity information and transforms this into a haptic cue that the user can understand. Thereby by moving the device from beacon to beacon a person is able to determine if they are getting closer or further away from the target zone. This form of active exploration may be thought of as analogous to the 'hotter/colder' children's treasure hunting game, in which the treasure hunter is only told whether they have got closer or further away from the treasure. In much the same way the haptic theatre technology never informs the user directly in which direction the target is located. This they must determine through active exploration, moving around in the environment to get more data.

4. EXPLORING NAVIGATION IN AN IMMERSIVE THEATRE CONTEXT

As part of the design process we organized two sessions in a large pitch black lab space in order to identify potential technical issues for the beacon network, and to explore whether participants would be able to use the enactive navigation device within the immersive theatre context. For both these sessions we created a pitch dark area of about 4 by 6 meters, and a ceiling network of nine beacons. Sighted and blind members of the project team, as well as a number of other volunteers navigated through this space holding a very early prototype of the haptic device. (Figure 1).

Sighted participants had not seen the space with lights on before they entered and were thus not aware of the layout, or the dimensions of the space they walked through. However, they had been instructed about the use of the device in daylight.

Figure 1 – Exploring the dark with an early prototype of the handheld haptic device.

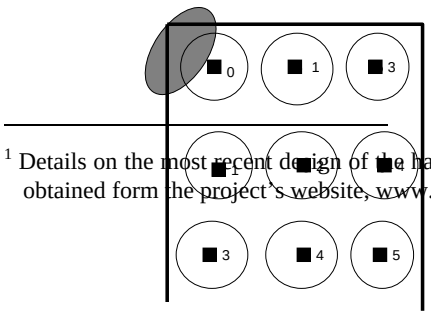
The early prototype used during these sessions works by the participant holding their thumb on the dial situated at the top of the device as it moves around in response to the signals it receives. If the dial is pointing towards the participant, the device indicates that they have arrived at the place of interest. If it points away from the participant, they are furthest away from the location. They can tell by the way the dial moves whether they are getting nearer or further from the location – but not in which direction they should set out. We are aware that this prototype does not have a very intuitive approach, and in particular, that the use of a dial is misleading, as it leads people to think that direction is being indicated. However, it was sufficient for these sessions as they were not about the esthetics of the haptic device, nor about its precise usability, but rather about the idea of enactive exploration itself and its integration with the tactile set and the audio. [1]

Session 1 – Integrating Audio and Navigation

Session 1 mainly focuses on the enactive navigation and its integration with the audio. The layout of the beacons for the dark space is as shown in Figure 2.

There is one target zone for participants to find, in which (random Jazz) music is played. This music can only be heard by someone wearing infrared headphones while standing in the correct location.

This session was the very first time that the concept of enactive navigation using beacons and handheld haptic devices was being explored in a realistic setting, and thus allowed us to explore a number of issues. For example, are participants able to move around in the dark, or do they remain in one spot? Do participants understand that they have to move in order to get feedback? Are they able to hold the device in such a way that the device can pick up the signal? Can they find the special location in the dark area? Do they know when they have found it? Are participants OK with having to wear headphones while walking through the dark?



[1] Details on the most recent design of the hand held device can be obtained form the project's website, www.theQuestion.org.uk.

Figure 2 Top view of the layout for dark space for workshop 1. The dark lines indicate the walls of the dark space which could be entered from one side. The area of audio is located in far left corner of the space. Each beacon, represented by a small black square, sends out a signal that can be picked up within a specific area, indicated by a circle. Each beacon sends out a specific code, which indicates the proximity to the target.

Our findings from informally observing the participants and talking to them afterwards were promising – most people were able to find the target zone and understood that they had to move. However, we also found that most participants struggled at those moments when they felt they received no feedback. Figure 2 shows that there are considerable areas within the dark space in which there was no signal, indicated by the gaps between the larger circles. Those gaps were proving problematic, as participants appeared to lose confidence in their ability to navigate.

Initially we thought that those 'no signal' zones could provide an interesting 'wondering' mode of moving around, which might be quite appropriate for the context of an immersive theatre. However, most participants seemed to express slight discomfort with this occasional lack of feedback, and hence we were swayed that this should be improved for future sessions.

In terms of the integration with the audio the session provided an important breakthrough. During the life of the project discussions about ways to trigger sounds at the right moment had been a technical stumbling block, causing problems in the design of the immersive theatre experience. Pressure pads and various buttons to be pressed had been discussed, all of which were meant to ensure that each participant would start at the beginning of the narrative for that location. However, all these solutions required additional technical workarounds which were problematic within the tight schedule we were working towards. The simple method of streaming sound from an MP3 player using infrared, which is thus only detectable by the wearer of infrared head phones when they are standing in a narrow zone, proved very successful. All participants seemed to genuinely enjoy the moment they found the music, and interestingly, most people seemed to have forgotten that they were wearing headphones. A similar result was found in the Riot!1831 project[5], where participants particularly enjoyed being able to stroll around the square, relatively unencumbered, "with their hands in their pockets", not having to do any of the pushing of buttons usually associated with interactive museum displays. During our first session we also noticed participants deliberately stepping in and out of the audio zone, with the audio fading in and out, and this was clearly something that people enjoyed.

Session 2 – Integrating Audio, Tactile Set and Navigation

The second session was to test how the tactile set elements could be integrated with the navigation and the audio. The design of the beacon had also been improved to send out stronger signals, with each beacon now covering a larger area. We wanted to investigate whether participants now have more confidence in using the system.

Again members of the project team navigated through the dark space. The improved signal coverage had a positive effect as most people had no hesitation in finding the location and felt very good about their ability to find the location. The design of the haptic device itself had also been improved to give a stronger and more responsive signal which also appeared to contribute positively towards the experience.

For this second session the audio was no longer random music, but was part of the actual recordings made for the final production, and thus actors' voices could be heard speaking lines from the script written for the theatre experience. The target zone also contained objects and textures that have a relationship with this narrative, and which could be explored through touch.

The navigation through the dark with the device was also felt to be a 'dense' experience. Density refers to 'object thickening space' in [10] and effectively means that it is possible to either hear the critical mass of an object in the dark as you approach it or feel it's presence. By describing navigating with the haptic device as a dense experience, we have an indication of the potential for audiences to feel the proximity of the target zones through the device. On finding the target zone the combination of audio and tactile set held some surprising effects – on touching an object it seemed as if it changed depending on which part of the narrative was provided by the audio.

5. DISCUSSION AND FUTURE WORK

We described some preliminary findings for the use of a mobile navigation device in helping guide people towards the targets. The first prototype mainly suffered from not being sufficiently responsive, and thus not giving participants confidence in their navigation abilities. By strengthening the signal of each beacon, and by making the reaction of the handheld device more immediate, participants seemed more at ease with the device, and confident in finding the location. The results from the second session look promising as the device appears to support the haptic theatre experience rather than distract from this experience. Participants describing the experience as dense would mean that the device can potentially be seen as part of our own body, and allow us to 'sense' the presence of target locations.

The next step is to put together the complete immersive theatre experience with all the elements in place. This will be staged in a London theatre, for a whole week, with several performances per day, so that groups of five to six audience members at a time can explore the dark space. Participants will be given a properly designed haptic navigation device that will be pleasing to hold, and that participants, hopefully, will feel they can trust and thus allow them to go on a journey through the darkness. We are planning an extensive user experience evaluation.

6. ACKNOWLEDGMENTS

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