Art, Design, Education and Research in Pursuit of Interactive Experiences

Geoffrey Shea

Ontario College of Art & Design
100 McCaul Street, Toronto ON M5T 1W1
(1) 519 369 3025

gshea@faculty.ocad.ca

ABSTRACT

In the development of mobile and location-specific experience creation, artists, designers and researchers at the Ontario College of Art & Design are developing new approaches to creation and collaboration that take into account the realities of artistic, academic and technical cultures. These included iterative creation strategies, co-evolution of technical platforms and cultural content, and rapid prototyping through charettes.

This paper will examine some of the strategies employed across several projects which all focused on creating new content and new types of content delivery for users of mobile devices, particularly cell phones. It will draw examples from games, sound compositions and virtual theatre experiences.

Categories and Subject Descriptors

I.3.6 [**Computer Graphics**]: Methodology and Techniques *Interaction techniques.*

General Terms

Documentation, Design, Experimentation, Theory

Keywords

Design Case: best practices, cultural aspects of design, design analysis and rationale, design cases

1. INTRODUCTION

The goal of the Mobile Experience Lab[1] research team at the Ontario College of Art & Design (OCAD) has been to develop new types of 'mobile experiences,' including user interactions mediated by handheld devices (cell phones and PDAs) and the necessary hardware and software support infrastructure. These include game-like experiences, communication opportunities, social networking, cultural content delivery, data sharing and other novel interactions. We consider the emerging domain of mobile, personal devices ripe for this kind of inquiry because it is expanding and evolving rapidly. The evolution from voice only services or non-networked services to text messaging, rich media exchanges, data networking and Internet connectivity has happened quickly and the introduction of new functionalities such as Bluetooth, Wi-Fi, RFID, GPS and smarter devices suggest that this evolution will not slow soon.

There are four major factors that can affect this evolution: the availability of services from cellular and other network operators; the built-in or extendable features supported on existing handheld devices; the expectations and needs of users; and the developers who work within and around these realities to imagine and create new applications.

The Mobile Experience Lab team is taking on this last role. Working in the context of an art and design university which has had a long history supporting emerging practices and the early adoption of new technologies, we are seeking to apply artistic and academic principals to the challenge of conducting research and development in mobile experience design. It should be noted that the resulting activities borrow from principals established in software engineering, ethnography and the social sciences, commercial R&D, and the singularity of artistic research. These principals include: transdisciplinarity, transparency, self-reflexivity, destabilization, agnostic democracy, participatory design, iterative cycles, rapid prototyping, extreme programming and 'inside out' experience design.

The other realities at play are that, while this is a faculty led research project, government funding introduces certain expectations, industry partners participate at various levels and student research assistants and staff engineers play a large role in the creative process and analysis.

Here I will review and describe several of the concrete results of our work, and the processes that led to them. In each, the coupling of artistic impulses with other methodologies has driven the project forward. The result is an increasingly effective, transdisciplinary approach to the questions of: What novel or unique user experiences can we create with locative media? and: How do art, design, education and research coalesce into one practice?

2. BACKGROUND

In deciding to explore the emerging capabilities of cell phones as a potentially rich, cultural and creative domain, the researchers at OCAD decided to work from the ground up. That is, every aspect of the creative process was open to review and re-review as successful (and not so successful) experiences in the practice of creation accrued.

The first factor was the composition of the research team itself. OCAD is a university with a long history of teaching and practice in both the haptic and digital arts. The faculty researchers all have cross disciplinary experiences combining cultural studies, ethnography, scriptwriting, documentary and feature film production, visual and media art, graphic and interactive design, architecture and music. Plunging into interactive content production for cell phones was a new challenge, but not an unprecedented one.

The proliferation of cell phones across the world made the proposition attractive and, although cell phones themselves are not a new medium, their recently expanded capabilities mean they can be viewed as a new platform for exchange of ideas, images and experiences.

A pivotal consideration as ideas moved from the brainstorming stage to technical deployment was the relationship and forms of dialogue between the technical and engineering staff and the creative artists, designers and social scientists. It was established early on that project development could not proceed in a linear or 'top-down' fashion, with ideas being handed over for production and very little experimentation and research flowing the other way. As a result, the engineers were considered integral to all imagination sessions. They provided valuable feedback on blue-sky ideas and brought additional thoughts on structure and content to the table that further stimulated collaborative brainstorming.

As ideas emerged and coalesced, underlying themes and topics became apparent. While the team explored maps, data flattening and the attendant reduction of representation was discussed. When games were explored, the dichotomy between chaos and control became an issue. Musical collaboration sparked talk about ethnocentrism in western culture. And the very idea of creating for a platform that seemed to encourage consumption and domination by near monopolies raised the ethical issue of the digital divide. These underlying social issues, already familiar to most of the researchers in their other work, were as dominant in subsequent discussions as the practicalities of building a game or creating a soundtrack.

3. TECHNIQUES

In the education of university art and design students at OCAD, and in the practice of the researchers involved, a range of stimulating and provocative exercises are regularly employed. The implication with many of these strategies is that the process that drives creativity and research is one that favours discovery, a principal long familiar to artists.

Brainstorming in groups encourages the quick flow and evolution of ideas and complements the prevalent view of the artist/designer-as-visionary. While individuals can enter into these dialogues with proprietary ideas, and can leave to pursue their own vision of how to implement them, the process of exchange and discourse underlines the fact that cultural and creative acts take meaning and relevance from the social context they are embedded in.

Brainstorming is a decades old collaborative technique, that more recently has expanded to include bodystorming. In these exercises participants are encouraged to move the creative impulse beyond the imagination into physical acts of spontaneous invention. For example, in our research one of the underlying themes that emerged as relevant to the social networking that is enabled by ubiquitous connectivity was characterized as 'flocking' or 'swarming.' In order for the faculty and student researchers to gain a practical sense of the general experience of flocking (as opposed to the already specifically mediated versions such as flash mobbing or Facebook) exercises were devised such as tying groups of individuals together by string and asking them to navigate an obstacle course without ever allowing the string to touch the ground. These playful, real-time collaboration games challenged the artists, designers and engineers to quickly come up with strategies and communication tools that could later be examined for their applicability to online experiences.

Another example of an imaginative design strategy was the adoption of an iterative creation cycle. In software engineering, the iterative cycle requires that an application be built in a rough form and tested with users for effectiveness and unforeseen complications. Revisions to the functionality and refinements of the overall application are then implemented and retested. In theatre this process is called workshopping. In music it is called jamming or improvising. In the projects described below, a series of versions of a mobile interaction would be envisioned, each delivering an increasingly enhanced experience and requiring more complicated software and hardware engineering. Before moving from one version to the next, testing would be done, sometimes indicating the need to backpedal and other times suggesting a new tangent in the development path that could be more fruitful than what was originally planned.

Where possible, the researchers employed rapid prototyping or charettes to focus ten or twenty artists, designers and engineers on a number of specific and narrow challenges. In contrast to brainstorming, which typically allows everything under the sky to be explored, charettes would ask for as many possible solutions to a specific problem to be imagined, developed and tested in a very short period of time: usually two or three days. This non-critical development environment favours quantity over quality; it assumes that ten working solutions to a particular challenge are likely to result in the discovery of an ideal one.

Brainstorming, bodystorming, iterative design cycles and design charettes were among our most useful creative strategies. Combined, they allowed for a flexible, responsive and evolving sort of creation and production that tugged at the imaginations of the artists and designers while constantly re-examining the technical paradigms under development.

4. TOOLS

The goal of encouraging quick and evolving interactive experiences for users of cell phones presented some very significant, basic technical challenges. The Mobile Experience Engine (MEE) became an early and important goal of the overall Mobile Digital Commons Network project, designed specifically to allow rapid development of media-rich, interactive applications for a large range of cell phones.

MEE lead engineer, Tom Donaldson, characterized the challenges specific to the mobile domain as: [2]

- Mobile devices have insufficient performance and too much variety to support client-side interpretation of high-level languages such as JavaScript or XML (typical in web design situations) for any but the simplest of applications;
- Mobile devices have widely differing capabilities, limitations and usage and this means that tools must be re-designed from scratch to deliver meaningful capabilities;

- Locative and sensor-based experience design is challenging, and in particular, testing is time-consuming and difficult.

The Mobile Experience Engine is a software development kit for creating advanced applications and media-rich experiences on mobile devices. It is particularly designed for creating mobile experiences that rely on and correspond to the user's position in the real world: 'locative' mobile experiences. Simultaneously the experiences rely on sensor input either from user actions, such as gestures, or on data from the environment, such as light levels and noise levels.

At first, the researchers formulated and produced a series of iterative, interactive and immersive locative experiences that relied almost entirely on the sound capabilities of GPS and Bluetooth-compatible cellular phones. The supporting applications were quickly developed with the MEE and a range of content experiences were created by artists and designers, who, importantly, could request revisions to the functionality without requiring significant engineering input.

The application of the MEE allowed designers to rapidly test out a range of probable and improbable solutions and to consider the shift from simple consumption to more active forms of user engagement: co-creation, play, re-mixing, etc.

(Other software development tools currently being used include Python and Processing, and Android is currently being explored.)

5. CASE STUDIES

The researchers at the Mobile Experience Lab created a number of user experiences designed for users of mobile phones. All included original software applications, often incorporating GPS, Wi-Fi, Bluetooth, central servers and the cell phone networks, and sometimes required the innovation of new hardware. Most of these user experiences took into consideration the concerns raised early on in the project and approached the end product as a hybrid experiences: part game, part storytelling, part documentary, part entertainment and part educational.

5.1 Alter Audio

OCAD faculty Paula Gardner and Geoffrey Shea constructed a series of interactive sound experiences for presentation on cell phones. These were designed as a series of iterative development exercises, each exploring different technical possibilities and a range of content types and user engagements.

Since locative media "can express an index of spatial relationships"[3] it was important for the artists, designers and researchers involved to focus on two things: the social and spatial interactions possible in a mobile experience; and the depth and impact of a mediated, co-created artwork.

The social use of sound to claim space as a territory is apparent in the use of personal listening devices from iPods to boom boxes to car stereos and security alarms.[4] Social relations examined here include the immediate collaborative expectations of multiple users affecting each other's aural experience through their relative movement, proximity, gesture, etc. Beyond that, the placement of the experience into a public space, such as a park, necessitated consideration of the immersed participant's relation to other, non-participating users of that space. And finally the adoption of controlled networks (GPS, cell service) by 'independent' creators required an examination of their encoded agendas.

The production of immersive artworks within this context demands that we move beyond the "functions, structures and subjective experiences of technology"[5] and to consider the shift from simple consumption to more active forms of engagement: co-creation, play, re-mixing, etc. Alter Audio sought to create ten software platforms that could be deployed for different expressive ends by artists, storytellers and musicians. These allowed for various levels of interaction between participants and different reactions to the overall experience.

At a charette (or workshop) in Toronto in June, 2006 three participants worked with Gardner and Shea and engineers to implement the first four of ten planned iterations:

Orchestra

Four pre-recorded, looped sounds are installed on one phone and a user can turn sounds on and off with buttons and an on-screen display.

Choreography

One pre-recorded, looped sound is associated with each of four phones and when the phones are within Bluetooth range of each other, each user can hear the other's sound.

Choreography & Control

Two pre-recorded, looped sounds are associated with each of four phones and when the phones are within Bluetooth range of each other, each user can hear the other's sounds. Each user has the option to turn either or both of their sounds on or off; other users within range will hear these sounds turn on or off.

Environmentally Located Sounds

Up to five sounds are associated with five specific GPS regions; a phone within a region plays that sound.

The three artist/designers who worked with us during the charette were students or recent graduates from OCAD. They were presented with the capabilities of the iterations outlined above, shown the Orchestra application and the plans for future development. They were asked to imagine what approaches they would take to preparing content for these applications and what sort of additional capabilities they would like see. Then they went into brainstorming and production, creating actual audio content that could be deployed on the applications of their choosing.

The third iteration, Choreography & Control ran into an engineering bottleneck and was not available for testing, although a suite of audio content was created for it. The fourth iteration, Environmentally Located Sounds, only became available on the last day and a production could not be tested during the charette. Other than that, all of the productions were installed on devices and tested in the field.

Applications In Use At The Charette

Prior to the charette the researchers created two content applications. The first was for Iteration 1: Orchestra. This included four tracks, two seconds long each. Three tracks contained different one-bar, musical phrases in 3/4 time: a bass, spacey guitar and a snare drum; the fourth track was a short, spoken phrase. When each loop was started by the user, it would not necessarily start in synchronization with the other loops. Because these tracks were so short and there was no harmonic

progression (i.e. movement from chord to chord), the effect was a vague sense of rhythmic complexity: the guitar, for example, playing a fraction of a beat behind the bass. Users very quickly acclimatized to each new 'dub' version that starting and stopping sounds created.

Here we see the artistic strategy of chance. What originally appeared to be a shortcoming (the absence of synchronization) was successfully converted into a creative asset. This opportunity to play—to create new rhythmic combinations—only became apparent through user testing and observation.

The second content application was for Iteration 2: Choreography. The aural experience of Iterations 1 and 2 are the same: four audio tracks turn on and off in different combinations, and loop with no particular synchronization, but in Iteration 2 the control is less specific. Rather than direct control by buttons, sounds turn on and off when other users move in and out of Bluetooth range. Bluetooth range during our testing was somewhere between 3 - 10 meters, depending on the electronic 'noisiness' of the environment, the number of phones involved, physical structures like walls, etc. By design, a single user could not affect a particular combination of sounds by herself. If, for instance, she wanted to hear the sound from User B's phone and moved towards User B, she might inadvertently move out of the range of User C. During testing all the users would first tend to understand how close to each other they needed to be. Since this distance tended to vary, and the other users tended to be continually moving, it was common for any user to hear only one or two sounds at a time. All four users would eventually bunch together, though, to hear the possible combination of all available sounds and to verbally compare experiences. This resulted in an unexpected social experience overlaid on the artistic experience.

When this iteration was first deployed a user never heard her own sound; this added some confusion about which sound was associated with which other user's phone. There also seemed to be some lag in the Bluetooth connectivity, so even if a user moved into range their sound might not turn on for 5 - 10 seconds, sometimes creating the impression that the sound was triggered by some other event such as another user approaching or a user walking away from the associated cell phone.

(In these iterations the basic software design works on the premise that each phone involved has been specially prepared: they have the software application and the sound files pre-loaded, and they have each been assigned identifies that will allow them to be properly recognized by the other phones running the application—for example, this phone is 'guitar', that one is 'bass', that other is 'voice', etc. So when another user approaches, the effect is that you hear 'their' sound, but in reality a sound associated with their identity and which is already installed on your phone, begins to play.)

Charette Guidelines

The participants were given minimal guidance regarding the design process that would ensue during the charette. We asked that they create a variety of types of content, pay attention to the relationship between form and content, and the relationships between technology, content and space as it relates to the user experience. We gave them some examples of how we have imagined these relationships, for example: choreography, metaphor and orchestra. And finally we asked them to consider what changes in the iterations would push the limits of the currently imagined and designed sound experiences. As a goal, we asked each participant to produce 2-3 audio productions per iteration, in rapid prototyping fashion.

With each day, participants became more familiar with the charette model, the software capabilities and with imagining sound experiences. Some participants tended to enjoy rapid prototyping while others took a more deliberate and thoughtful approach to content creation. Importantly, the participants immediately engaged in a critique of the perceived strengths and weaknesses of the software and imagined different user experiences based on more complex and capable software. Participants were guided to work within the existing limitations and to see how far creative content could push the limits of these iterations and still be engaging or enjoyable to users.

Participant Observations

Although the platforms we were developing were intended to deliver content to end users, we considered that cultural creators were our immediate target audience. The charette participants needed to tell us how well the tools we produced allowed them to create expressive content. For this reason we did extensive observations, interviews and analysis of the participants' reactions to the experience of working with our applications.

To summarize:

Mark Poon felt that iteration 3 seemed like part of an orchestra, whereby individuals could each have an instrument and try to create a symphonic arrangement from it. He imagined hundreds of people and lots of symphonies existing, with users joining the group that interested them.

Nigel Craig was interested in the possibilities of community building through collaboration, and interactivity though the sound experience. He was also interested in addressing human scale and building to that scale. He strongly felt that the available iterations were constraining and wouldn't allow sufficient interactivity and so brainstormed new future iterations. For example, he tried to think of interactivity in other ways such as outdoor games or user content feeding into the experience. Nigel wanted to turn the user's expectation upside down through their experience.

John Pavacic's initial response was to think ahead, imagining future iterations because he felt early ones seemed too much like prototypes. He adopted a 'marketing perspective' where users would want to 'buy in' down the line. John was interested in leaving virtual items and artifacts in the space, thinking of games that had strategies and got people out into the park, developing more mysterious and fun experiences, and creating interactive experiences that made people want to play with the phone instead of simply creating an experience as a 'tacky add-on' to existing phone use. Finally, he thought about creating an application that would allow each user to have a unique experience. This led to a conversation about how the experience might change over time, as users played, so that one would never have the same experience twice. We thought about programming the experience so that it changed based on events that previous players engaged in.

The team discussed the benefits and drawbacks of using headphones: that they allow the use of left and right stereo channels that can produce the experience of being unsure which space is generating which sound, and can pan 360 degrees. We discussed whether we were less engaged in the physical environment if we used headphones and what would happen if we

could loop ambient sound through the headset. (One of our early testing locations was the Banff National Park where we were forbidden to use headphone due to the risk of attack by bears.)

We looked at issues of simulation versus actuality—for example, the different experiences of simulated versus actual cell phone conversations and the potential attraction of each to users. We discussed various ways to motivate users to keep using the limited and constrained iterations, such as providing rewards, pleasure, and playing on the 'negative space' of the functions. For example, if users were allowed to turn off certain functions, how would this affect the experience?

We brainstormed about general approaches to creating appropriate content for the existing iterations. Iteration I possibilities included: jazz music in same key; sound effects; hip hop; sampled sounds and music of different lengths. Regarding GPS, we wondered if users themselves could deposit information at a virtual geographic location that would link data to a space that other users could access. We imagined this would play into the nature of the cell phone, making it distinctive from other locative audio-visual media, since the cell phone inherently implies movement or mobility. We imagined possibilities for site memory, such as a message board, which creates a cache-like record, so that everyone can leaves 'scar tissue.' By connecting to a cache, users would be able to hear the messages such as, for example, electrical connections to a netherworld. We imagined users themselves being sampled by the technology as they passed a node, and the counterargument that this could be a form of surveillance.

Productions

Since synchronization of the looped sounds was not available (although we later revisited these iterations and added synchronization as an engineering requirement) the musical compositions that were created sought to work within that given reality.

Jam

John created content for Iteration 2: Choreography that allowed four users to share sounds based on their Bluetooth proximity. Because sounds couldn't sync up, John focused on rhythm, using triplet notes in his beat. The tracks included one instrument track that played to a 12/4 melody resolving briefly on the fifth and second of B, one playing long, sustained tones (aii, bii and bi), one playing syncopated percussion sounds and one featuring two distinct bird sounds in sequence. Each loop was 5 seconds long. Because the sounds were so different in texture and tempo, he projected that they would work equally well together regardless of the lack of synchronization.

In fact, users reported that the effect was esoteric and reminiscent of experimental forms of audio art common a decade or two ago.

Vocal Chords

Nigel took a very different approach to Iteration 2: Choreography. He created four 60 second loops that included a sequence of sung tones in the key of C, two using a male voice and two using a female voice. He reasoned that the human voice was a common musical element in many different cultures and that the C scale was, if not exactly universal, at least common. Each loop had 5 to 6 notes of about 10 to 12 second durations. These were:

Female: ci a g di f b

Male: B f e g c

Female: di b ci ei g f

Male: g d f e c

Because there were a different number of sounds combining, depending on the position of the four users and their phones, each user would hear from as little as nothing, up to a three tone chord. (Remember, in this build of the iteration a user would not hear their own sound.) Because the sound loops would start at different times there was an immense variety of possible chord combinations and the chords would tend to evolve into other chords one note at a time, at times suggesting other modes based on the C scale.

The reaction among testers was that the constant and unexpected variation of the tones and chords created a pleasant sense of anticipation that was seldom stifled by recognition of repetitious or predictable patterns. While Nigel's careful consideration of cultural context resulted in only one actual production, the net result—a highly evocative, shifting harmonic pattern—was only partly predictable.

(Nigel prepared an eight track version of this piece for implementation of Iteration 3: Choreography & Control, in which each of four participants has two associated sounds that they can optionally turn on or off. He projected that having all sounds on would be unsatisfying because six or eight note chords are difficult to discern, and this would encourage users to start stripping away sounds until a satisfying combination was achieved. This remains to be tested.)

Soundtrack to Your Life

Mark created an experience based on Iteration 4: Environmentally Located Sounds, which allows designers to specify five GPS locations that would each be associated with a different sound, to be experienced by a single user. The locations would typically have a centre and a region defined by a radius (i.e. anywhere within 10 meters of this rock is one region). One problem that we anticipated with GPS is that the regions tend to drift, that is, they would move around erratically as the GPS device connected with different satellites. We are still measuring this drift but it seems that it may move scores of meters every few seconds.

Mark chose to have all five regions concentric, so they existed in circular bands around a single, central GPS coordinate. Each ring was defined as 15 meters wide. If a user traversed each ring, moving directly towards the centre of the GPS region they would encounter five, equal sized bands with accompanying sounds. If the user moved on a lightly tangential path the rings would not appear equal sized and the user might not ever encounter the innermost rings. (John will begin to address this eventuality below.)

Mark took an orchestral approach to his sound creation. The five tracks move subtly from a 16 second sequence of four arpeggiated chords combined with bird sounds to a fuller score with a bass, violin and cello playing in double time and a languid piano. Instruments were added one at a time over the original sounds creating the impression that the sound is growing. Although the sounds might skip as they restart when users transition from one region to another, the overall impression among testers was that the 'score' was building much like it might during the title sequence of a film. One user dubbed it 'starring in my own movie.' Mark used a 16 second sequence because he thought this

was the time it would likely take an average user to traverse one band of the region. The immersive experience is engaging, and heightens one's experience of walking the park by adding a soundtrack and removing most of the ambient park sound, especially when one wears headphones.

Moving Crowd

Nigel considered the instability of the GPS coordinates–their tendency to jump several meters every few seconds–as a feature to be incorporated.[6] He created an ambient sound installation for Iteration 4: Environmentally Located Sounds, using fairly densely packed regions, each one associated with a different crowd sound. He intended a nine region grid with each grid being square and only a few meters wide. He wanted to create the impression that, as a user stood still in the middle square of the grid, the crowd would be jumping around him and letting the GPS drift be the active agent in the experience. This remains to be tested.

Homing Signal

John created several series of short, looped sounds for Iteration 4: Environmentally Located Sounds, that would alert users that they are moving in the right direction. In each, the sounds sped up as users moved from GPS region to region, reminiscent of the familiar radar pings we have seen in so many movies.

Although this simple soundscape did not deliver a novel or moving musical experience, it did create an immediate satisfaction in users, who were able to quickly discern the function of the beacon sounds. With this we became more alert to the value of familiarity in the design of new forms of content in new delivery systems.

Post-Charette

As part of the ongoing development of this project the researchers have created or facilitated several subsequent content productions, learning from the experiences of the charettes.

An external composer, Dr. David Ogborn, was asked to create an original composition for one of these existing platforms. His contemporary music aesthetic relied heavily on the stereo capability of the handsets and his four, discreet sound channels each consisted of large spaces of silence between elaborately constructed burst of sound composition. The semi-random merging of these components created evocative, though not overbearing, results.

Shea and Gardner went on to create a spoken word, narrative composition, *Phone Noir*, in which the user's position between two Bluetooth beacons determined which of two voices they would hear speaking a poetic narrative. First presented in an indoor setting at an OCAD open house, the piece was later staged as part of one of Canada's leading poetry festivals: Words Aloud! In this setting it was required that the composition be presented outdoors, and so, with minor tweaking by the engineers working on the MEE it was transformed into a GPS-dependent experience within a matter of hours.

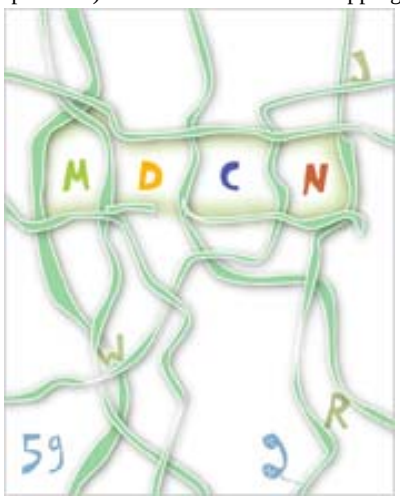
The applications and designs created allow users a host of experiences: to interact with passersby in an urban park, to engage with other users in shared musical composition, to record and deposit material in a space accessible to subsequent users. The MEE allowed designers to move beyond working around technological problems, to instead capitalize on the fullest set of system capabilities. As a result, Alter Audio was able to consider and test questions regarding the degrees and types of agency or interactivity users wanted, and to take careful account of the relationship between the design experience, device constraints and spatial paradigm.

5.2 Scramble: Co-Located, Real-Time, Locative Word Game

The Mobile Experience Lab researchers next developed a simple locative game, in which players in immediate proximity to each other or in distant cities could interact to solve a puzzle and position themselves in space to progress through a series of levels of gameplay.

Research Engineer Daviid Gautier (Hexagram/Concordia) used the Mobile Experience Engine to develop an underlying functionality for the co-located experience. He created an application which runs on multiple phones and displays the user's location within a delimited physical space (e.g. a city park) as a dot on the screen. As the user moves, their dot moves on the screen. Two separate physical spaces were overlaid so that three users in one city and three in another could all see each other interacting in the virtual space of the screen.

The technology used for this application is fairly straightforward. First, the information sent from the GPS satellites to the user's GPS receiver (giving the location of the receiver in physical coordinate terms: longitude and latitude) is transformed into pixel space on the mobile device. The physical-to-pixel space transformation is based on a central, reference point (established at the beginning of the experience) used as a base for the clipping plane (delimiting the area of interest, or the 'playing field') and a pre-computed ratio (in meters per pixel) is used to scale the physical space into the screen space. By doing this spatial transformation, we assure that the respective location data shared by all users is not directly tied to their physical coordinates (in Montreal or Toronto, for example) but rather to their relative position from the centre; in other words, users are mapped onto the same space: the pixel space.



After being computed, the pixel coordinate of the user is then sent over the Internet (via the GPRS or cell phone data network) to a database server. Other remote users then query that database (over the network) to retrieve the pixel coordinates of each user and use this information to refresh the position of each user's avatar on their mobile device screen. As a result, each user has the same information on their screens.

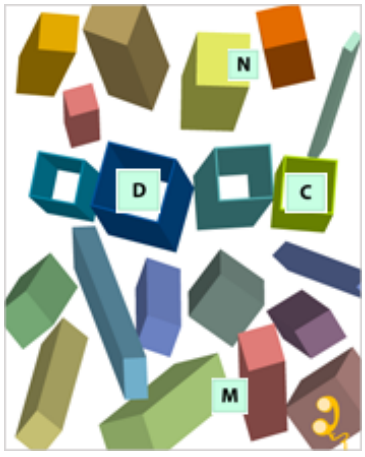
The research team reviewed this functionality and then sat down to devise a meaningful user experience that could take advantage of and extend it. Several scenarios were explored, including games modeled on scrabble, boggle, tag and football as well as

co-creative experiences like recombinant poetry. It was decided to pursue the simplest experience and add levels of complexity after refining and user testing.

By replacing dots on the screen with letters a simple locative spelling game could be developed. Daviid was able to provide this technical modification by the next meeting and demonstration two days later. Users in Montreal and Toronto (some working in pairs and some individually) were assigned four letters – two in each location. They were then challenged to arrange themselves in space to form the only possible word.

The first goal of the Scramble game development was to create an engaging game experience that would involve players in distant locations.

Notably, each player's location on the 'virtual playing field' was set to correspond to their actual physical location by using the application to set a reference point a the beginning of the game. As a result, each player could be anywhere in the world that GPS and GPRS services were available. In our test, users in Toronto all set their reference locations to roughly the same place (the centre of an urban park) and the Montreal user set their reference location in that city. It would be just as easy to have six players in separate cities, or separate locations within the same city, or even have them all play in the same physical space.



In the follow-up iteration we introduced the concept of levels of game play and a more refined graphical interface. Each level of play involved a 60-second timer which challenged users to form their letters into the proper word as quickly as possible. At the end of 60 seconds the game presented new letters and new words along with new graphic backgrounds that required increasingly challenging physical arrangements of players in space.

Further complexities were introduced in subsequent levels, including:

- Changing the resolution of the virtual playing field. For instance, in one level moving 100 meters in space might take you from the top to the bottom of the screen on your cell phone, while in another level you might have to move only 10 meters, or 300 meters.
- Changing the orientation of the axis. In one level walking north might move your letter towards the top of the screen; in another level moving west might move your letter towards the top of the screen.

After testing users had these observations about the experience:

- the first challenge was to determine how far one must move before having a visible affect on the screen (originally set to 5 meters/pixel)
- next, which direction on the screen corresponded to which direction in the physical space (i.e. north was not necessarily 'up')
- players in the same physical location talked and then shouted suggestions to each other until they were out of range
- some experimented with finding the edge of the playing field (about six city blocks from edge to edge)
- it was reassuring to be seeing some movement, even when one's own character was standing still or seemed a little unresponsive
- each phone had a 'set reference GPS location' function, allowing it to define its own playing field (in other words, each user could be in a different location, a few feet or a hundred miles away from the others)

The speedy development of this interactive, and somewhat social, experience demonstrated the value of having a hands-on engineering environment: in this case a team of designers and engineers who were all on the same page and the MEE which allowed for rapid prototyping and iterative design.

5.3 Portage

In this current artist/designer driven research project led by Shea and Gardner, a short street in downtown Toronto is being converted into a virtual theatre. Users with a broad range of mobile devices will be able to interact with participatory content experiences: spraying virtual graffiti on wall, turning surveillance cameras back on themselves, collaboratively remixing music tracks through choreography, or exploring the history of the specific locale. Users equipped with highly capable devices (e.g. with Bluetooth and GPS) will have one level of engagement, but others with simple voice or text capable phones will be able to access the experiences on another level. Even visitors with no device will be able to participate: by banging a steel drum for example, and creating a digital signal in collaboration with other online users.

I Spy

As an example, one user experience included in this streetscape theatre will be *I Spy*, a video surveillance experience. In the first iteration users will be able to review the content of a dozen Wi-Fi cameras which inhabit the environment, seeing and revealing themselves as they are seen and revealed by the private and public interests that typically invest in surveillance. Signal strength will determine which vantage is displayed on the user's device, so simply walking the street will result in a game of 'find the spy-cam.' [7]

A subsequent iteration, however, will blend the current images with historical images from different significant periods in the city's past, placing the user in the middle of another event. Beyond that we will introduce scripted narratives, sound, and nighttime versions of the experience.

The blending of issues such as the impact of surveillance, the historical specificity of a particular place and the active involvement of the viewer in the construction of the event speaks directly to the ambition to reveal art production and social science impulses in the design and creation of mobile, locative experiences.

Wall of Sound

In another project under the PORTAGE umbrella, a wall of crudely constructed, electro-mechanical musical instruments is being installed on the side of a downtown building. Users will be invited to 'play' the instruments: if they have Bluetooth capable devices they will be encouraged to download a small application that will control one device: for example a rhythm sequencer that will allow them to program a steel and concrete drum. If the user has a less capable device they will be able to dial into a voice-over-IP server and use the tones on their keypad to pluck a stringed instrument or increase the speed of a spinning speaker.

In either case, each will be able to hear the results of their and others playing, encouraging a virtual jam session. Importantly, even participants with no mobile devices will be able to input signals into the system by simply banging on a drum or turning the handle on a noise maker.

(It could be noted here that Canadian mobile use is among the lowest in the industrialized countries and 95% of users only have access to voice transmission, partly as a result of the absence of compelling data services and partly due to regulatory and commercial pricing structures.)

Cicada

Passive forms of user interaction are demonstrated through EMF (electromagnetic frequency) detection in Cicadas. In this project, users with active cell phones will trigger environmental responses without necessarily intending to do so. We are developing a 'swarm' metaphor to illustrate this effect: hundreds of electronic cicadas inhabiting a row of trees light up and chirp in response to passers-by making cell phone calls. The more users in the vicinity, the more vigorously the cicadas will respond.

6. CONCLUSION

We have demonstrated that artists and designers, working in the context of research at a university, can develop evocative and forward-looking, interactive experiences for users of handheld devices such as cell phones. Recent evolutions in the mobile domain, including networked, always-on, wearable data communication tokens and open source, mobile operating systems and application development platforms continue to demonstrate that the field is changing quickly. The involvement of socially oriented academic researchers, educators, artists and designers will continue to add fuel to the fire and encourage the creation of more examples of novel communication and content delivery experiences.

In all of these research and development initiatives we have stressed the importance of process. We have established that artistic practices enhance the potential for meaningful innovation, including: hands-on development, iterative creation, play and chance.

While other common approaches to designing complex systems, such as software, might include top down, bottom up and extreme programming, we find ourselves working from the middle of a set of capabilities and considering how those might be used to develop a unique and original user experience. At the same time, we interrogate or disrupt the capabilities themselves, imagining how they could be re-tooled to respond to the emerging needs of the content in a bi-directional flow of demands we have dubbed: Inside Out Experience Design.

Locative design seeks to connect a hertzian, online experience with a physical, real world experience. The artistic, design and site-specific needs of the envisioned content structures are well served in a practice-based art and design research context.

7. ACKNOWLEDGMENTS

The research and development described here was undertaken as part of the Mobile Digital Commons Network led by Sara Diamond and Michael Longford, through Hexagram (Concordia University), the Banff New Media Institute and the Ontario College of Art & Design and funded by Canadian Heritage; and in:

PORTAGE: The Canadian Mobile Experience, a research and development project led by Geoffrey Shea and Paula Gardner at the Ontario College of Art & Design and funded by Canadian Heritage.

Mobile Experience Lab faculty researchers included: Patricio Davila, Sara Diamond, Paula Gardner, Bruce Hinds, Martha Ladly, David McIntosh, Geoffrey Shea.

We thank our research team, engineers: Tom Donaldson, David Gauthier, Jagmit Singh, Sukhmeet Singh, Ken Leung and Rob King; research coordinator: Jenny Ziemianin; research assistants: Nevena Nilogova, Yvon Julie, Bryn Ludlow, and Peter Todd; and charette participants: Mark Poon, John Pavicic, Nigel Craig, Jennifer Johnson, Fiona Chung, Jennifer Johnson, Eliseo Reategui, Blaze and Carrie Young.

8. REFERENCES

[1] www.mobilelab.ca

[2] Shea, G., Donaldson, T., and Gardner, P. "Using the Mobile Experience Engine to Create Locative Audio Experiences." In Advances in Pervasive Computing, Adjunct Proceedings of the 5th International Conference on Pervasive Computing (Toronto, May 13-16, 2007). Osterreichische Computer Gesellschaft, Vienna, 2007, 91-94.

[3] Albert, Saul, 2004. "Locative Literacy" in Metamute Magazine. www.metamute.org/en/Locative-Literacy

[4] Sterne, Jonathon and Emily Raine, 2006. "Command Tones: Digitization and Sounded Time". First Monday, www.firstmonday.org/issues/special11_9/sterne/index.html

[5] Galloway, Anne and Matthew Ward, 2006. "Locative Media as Socialising and Spatialising Practices: Learning from Archaeology". Leonardo Electronic Almanac, MIT Press. www.leoalmanac.org/journal/Vol_14/lea_v14_n03-04/gallowayward.asp

[6] Benford, S., et al., "Coping with Uncertainty in a Location-Based Game", Pervasive Computing, July 2003. Available at http://www.equator.ac.uk/var/uploads/IEEEpervasive-nearlyfinal.pdf

[7] Ubiquitous Wi-Fi service, including identifying which node a user is connected to, is being provided by Toronto Hydro Telecom, one of our industry partners.