Objects of Wonderment

Eric Paulos
Intel Research
2150 Shattuck Ave #1300
Berkeley, CA 94704
USA

Tom Jenkins
Interaction Design
Research Studio
The Royal College of Art
London, SW7 2EU, UK

August Joki
Center for Embedded
Network Sensing
University of California
Los Angeles, CA 90095

Parul Vora
Design School
Human Computer
Interaction
Stanford University

ABSTRACT

While we should celebrate our success at evolving many vital aspects of the human-technology interactive experience, we question the scope of this progress. Step back with us for a moment. What really matters? Everyday life spans a wide range of emotions and experiences – from improving productivity and efficiency to promoting wonderment and daydreaming. But our research and designs do not reflect this important life balance. The research we undertake and the applications we build employ technology primarily for improving tasks and solving problems. Our claim is that our successful future technological tools, the one we really want to cohabitate with, will be those that incorporate the full range of life experiences. In this paper we present wonderment as a design concept, introduce a novel toolkit based on mobile phone technology for promoting non-experts to participate in the creating of new objects of wonderment, and finally describe probe style interventions used to inform the design of a specific object of wonderment based on urban sounds and ringtones called Hullabaloo.

Keywords

Wonderment, urban computing, sounds, ringtones, DIY, toolkit

1. INTRODUCTION

We are at an important technological inflection point. Previously, most computer systems were designed and built by professionally trained experts (*i.e.* computer scientists and engineers) for use in specific domains and to solve explicit problems. Artifacts often called "user manuals" prescribed the appropriate usage of these tools and implied an acceptable etiquette for interaction and experience. A fringe group of individuals usually labeled "hackers" or "nerds" [1] traditionally challenged this producer-consumer model for technology by hacking novel hardware and software features to "improve" these products while a similar creative group of technicians called "artists" re-directed the techniques, tools, and tenets of accepted technological usage away from their typical manifestations in practicality and product. Over time the technological artifacts of these fringe groups and the support for their rhetoric have gained them a foothold into computing culture and eroded the established power discontinuities within the practice of technology design. We now expect our computing tools to be driven by an architecture of open participation and democracy that encourages users to add value to their tools and applications as they use them. We have seen the "Web 2.0" phenomenon embrace an approach to generating and distributing web content characterized by open communication, decentralization of authority, freedom to share and re-use, and "the market as a conversation" [2]. Similarly, the bar for enabling the design of novel "hardware remixes" and systems has been falling to the point that many non-experts and novices are readily embracing the personally empowering experience of customizing their tools and systems [3-5].

But how have we as "expert" practitioners been influencing this discussion? By constructing a practice around the design and development of technology for task based and problem solving applications we have unintentionally established such work as the *status quo* for the human computing experience. We have failed in our duty to open up alternate forums for technology to express itself and touch our lives beyond productivity and efficiency. Blinded by our quest for "smart technologies" we have forgotten to contemplate the design of technologies to inspire us to be smarter, more curious, and more inquisitive. We owe it to ourselves to rethink the impact we desire to have on this historic moment in computing culture. In this paper, we choose to lead a dialogue that heralds an expansive new acceptable practice of designing for wonderment and to enable its participation by experts and non-experts alike.

To be clear we are not attempting to be trendy or solely create new media art. As Von Hippel points out, even profit driven corporations need to embrace this new computing culture to tap into their "lead users", encourage innovation, deliver mass customization products, and survive [6].

1.1 Goal

Our goal is not to provide general-purpose holistic solutions to problems within the complex social, cultural, political, and economic ecology of technology rich life. Rather, we hope to merely expand the vocabulary of potential everyday technologies, enabling a wider range of choices as we form our future computing lifestyles. Our final designs are intended to provoke open ended discussions around our technologies rather than present "killer apps" or final solutions.

1.2 Outline

This paper is broken into two main sections: Objects of Wonderment Toolkit and Hullabaloo. In the first section we present wonderment as a design concept, describe the development of an open toolkit based on the mobile phone for structuring the design of objects of wonderment, and discuss several small-scale deployments of the toolkit into the practice of everyday life. In the second section we detail a series of interventionist style techniques used for informing the design of a larger scale object of wonderment based on urban sounds and ringtones called Hullabaloo. We conclude by analyzing several long-term deployments of the Hullabaloo system in public urban settings.

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2. WONDERMENT

When Mark Weiser, arguably one of the founding figures of the field of Ubiquitous Computing, was looking for a metaphor to capture his envisionment of our future interaction with computing technology he wrote, “UbiComp needs a metaphor that reminds us of the value of invisibility, but does not make it visible. I propose childhood: playful, a building of foundations, constant learning, a bit mysterious and quickly forgotten by adults” [7]. It is this important element of human mystery and curiosity that we believe is underrepresented as a design practice for technological interactive systems. Further, we argue that such interactions, while difficult to place quantitative measurements on in terms of enjoyment, benefit, or even improved quality of life, are indeed essential elements of daily human life.

We invite the reader to think about daily life. More than just problem solvers, we are creatures of boundless curiosity. Mixed within our moments of productivity are brief instances of daydreaming. We find ourselves astonished and in awe of not just the extraordinary, but also the ordinary. We marvel at mundane everyday experiences and objects that evoke mystery, doubt, and uncertainty. How many newspapers has that person sold today? When was that bus last repaired? How far have I walked today? How many people have ever sat on that bench? Does that woman own a cat? Did a child or adult spit that gum onto the sidewalk? These are all feelings of what we call “wonderment” that color and enrich our lives. To some degree, we all experience such thoughts every day. These feelings are difficult to measure and nearly impossible to assign a value. Nonetheless, these episodes are part of our lives and as such deserve a place within the discussion of our future digital technologies.

We have chosen the term *wonderment* because it captures many of these important daily experiences in its definition. For example: to think or speculate curiously; to be filled with admiration, amazement, astonishment, or awe; to doubt; something strange and surprising; producing puzzlement or curiosity; the reverse of what might be expected [8]. With those experiences in mind, we aim to promote the design of technological systems that support such wonderment. Our work builds on a larger historical body of research exploring similar themes such as designing for the ludic [9], ambiguous [10, 11], strange [12], curious [13], slow [14, 15], noir [16], and hermeneutic [17]. More specifically we are interested in how we can design the *tools* that will encourage the production of objects that inspire wonderment over those that are engineered for task based problem solving.

3. WONDERMENT TOOLKIT

There is a long history of toolkit production for ubiquitous computing [18-22]. Our goal is not to replace such successful efforts but to produce a toolkit that would, by design, (1) cause individuals to rethink everyday physical objects and imagine their new role in directly promoting curiosity and wonderment, (2) focus on the construction of public rather than personal objects, and (3) be build around a familiar technological object – a mobile phone. The choice of public over personal was mainly a design constraint to counter the proliferation of personal digital objects and force a brainstorm around public territories and technologies.

Like much of the related toolkit work, we also desired our toolkit to allow non-experts access to new technologies. Our aim was to invite practitioners from a wide variety of backgrounds and interests into the important conversation concerning technology’s potential role across the full range of daily life experiences. By allowing non-experts to design and deploy new public objects, we also hoped to empower everyday citizens to participate in the authorship of their emerging digital urban landscape with emotionally meaningful technological objects that mattered to them.

An interesting architectural design choice for the toolkit was to undertake the deconstruction of the mobile phone away from its typical usage as a personal communication tool and instead physically attach it to a public place such as a light post, stop sign, tree, or park bench, sidewalk planter, *etc*. We further permute the mobile phone by attaching a collection of sensors and actuators to it, transforming its roll into that of public object. We argue that these “phones” are currently transforming into “super-computer-radio-station-with-sensors” and as such a rich design territory exists to explore their use beyond that of simply personal communication tool. In this new setting the mobile phone serves as the central element in our toolkit for promoting wonderment – the *Objects of Wonderment Toolkit*.

3.1 Mobile Phone as Public Urban Processor

Our approach is to the use of the mobile phone as the central computing platform for the toolkit (Figure 1), promoting a hacker style [23], DIY (Do It Yourself) method of making by using a standard everyday consumer technology as the basic building block. It is important that other single board computers and embedded processors are avoided as much as possible. This keeps the cost low as well as the accessibility of the system to a wide range of non-experts. Using the phone has several main advantages:

1. **Familiar urban object** – mobile phones have already adapted themselves into our everyday lifestyles where we comfortably cohabitate with them
2. **Commodity consumer item** – tremendous production volumes drive the price down for mobile phones leaving more raw technological power and functionality per cost than any single board computer or microcontroller
3. **Globally networked** – mobile phones come connected to the global network where data can easily be moved between devices, servers, and the web.
4. **Speak the lingua franca of the city** – by design they readily interact with many ubiquitous daily technologies such as Bluetooth, SMS, and MMS
5. **Color Display** – mobile phones provide a functional color display for output and debugging

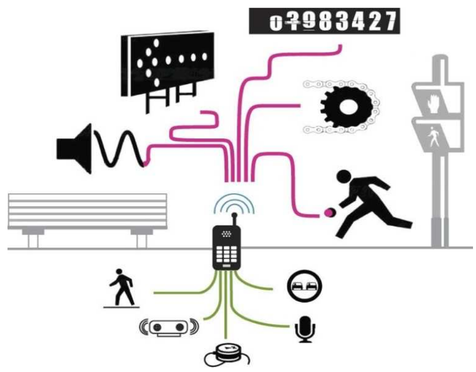

Figure 1: The Objects of Wonderment Toolkit is an open source mobile phone toolkit designed to expand our expectations of mobile phones as they shift from a social communication tool to visually programmed public objects with attached sensors (green) and actuators (red).

3.2 Enabling Product Reuse

Currently our mobile phones are doomed to live out only short product lifespan. As these fully functional objects fail to satisfy our technological fetishes and trends, they are replaced – every 18, 15, and 9 months in the United States, Europe, and Japan respectively [24]. While manufactures offer incentives to recycle mobile phones, a European study finds that only 10% are actually recycled, 18% given to someone else to use, and 65% "placed in a drawer" [25]. The numbers are even more disconcerting in the United States where less than 1% of mobile phones are recycled [26]. Of course the question is why these "drawer bound phones" are never recycled. However, it also represents untapped potential for further use of the device beyond its originally intended purpose as a communication tool. This 65% is a significant quantity of phones that could be repurposed for further life serving as the cores for *objects of wonderment*. While it does not solve the problem of recyclability of mobile phones, it prolongs product lifetimes, encourages a rethinking towards reuse of technologies, and promotes an awareness of the global problem of electronic waste on the ecosystem.

3.3 Toolkit Architecture

The overall goal of the objects of wonderment toolkit is to allow a non-expert to take an idea for promoting wonderment, visually describe its functionally, easily attached necessary sensors and actuators to a mobile phone, and execute the code and hence delver the desired experience. This is indeed a lofty goal and while we clam success on some aspects of this goal it is far from general purpose to allow a full range of complex operations to be performed.

3.3.1 Visual Programming

We opted to use an Adobe Flash application as the tool for creating the visual programming part of the system. Flash allowed us to use a tool with existing aesthetically pleasing visual elements, permitted users to access the toolkit through an inexpensive, familiar interface (*i.e.* by simply visiting a Flash based web page), operate on multiple platforms, and design towards a future version that allows on mobile device visual programming through FlashLite which runs on multiple mobile platforms.

The visual layout consists of draggable elements from a menu located on the left side of the screen and a programming canvas on the right (Figure 2). The user can select one of three primary modes for the draggable menu – sensors, actions, and conditionals.

In the sensors mode, users can select from a range of mobile phone onboard sensors such as microphone, camera, Bluetooth, light levels, and receive SMS as well as attached sensors such as buttons, switches, potentiometers, analog sensors, carbon monoxide, serial based hardware, accelerometer, *etc*. It basically supports a wide range of digital, analogue, or serial devices to be attached. Similarly the action mode allows phone based actions such as dialing a phone number, sensing an SMS, and playing a sound as well as controlling attached elements such as driving a relay, servoing a motor, *etc*. As with the sensor mode, it supports general purpose digital and serial based output to devices. Finally, there is a conditional mode that allows the use of various programming elements such as conditionals, waits, loops, thresholds, *etc*. With the combination of these elements users create visual programs by connecting up the input and output pieces of each programming block. When the final program was assembled a user selected "save" at which point an XML file was written describing the program blocks

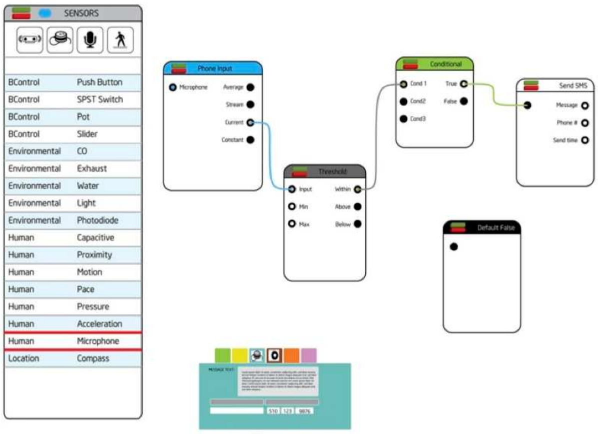

Figure 2: Visual programming of an application to have a particular sound picked up by the phone's onboard microphone trigger sending of an SMS

and connectivity. The file could also be sent via SMS to a mobile phone for execution and debugging. A simple program is demonstrated in Figure 2.

As with most visual tools, the advantage of simplified programming is a tradeoff against the complexity of applications that can be built. Of course if we allowed users to create their own block it would expand the application space, but it would also require extensive knowledge of the esoteric and painful programming environments of mobile phone software. In our system we wanted to see how people could use the system as designed without resorting to custom user designs.

3.3.2 Kernel and Hardware Interface

The core piece of software code is a piece of signed J2ME software that acts as a kernel. It reads the XML file generated by the visual programming tool and generates the correct execution model. In our original version it models a single process execution. That is, the kernel starts at a user defied start block and follows the code execution as it progresses, reading sensors, passing values to the next execution block, *etc*. To simplify the system it does not allow out of order execution or interrupts. This limits the types of programs that can be written but simplifies the overall design and avoids a host or race conditions and deadlock states.

In our example we used Symbian based Nokia S60 mobile phones where we installed the J2ME kernel. Interestingly the signed application allowed users without permission to be granted, thanks to the signed kernel, access to features of the phone that were not available to typical users. This included the sending and receiving of SMS messages, reading and writing files on the phone, and playing sounds, recording audio, and controlling backlights.

It is also important to access sensor and actuator hardware not embedded into the mobile phone. To do this we integrated Bluetooth hardware that supported a selection of a dozen digital and analog I/O pins as well as RS-232 serial protocol for external peripherals. Again, the kernel allowed access to this by relaying user requests such as analog sensor readings or driving digital signals to the Bluetooth module for processing. An image of the phone and supporting Bluetooth module is shown in Figure 3. A 9 volt battery typically powered the Bluetooth module.

Figure 3: A mobile phone and wirelessly integrated Bluetooth module for supporting analogue and digital I/O

3.3.3 Executing Code

To execute the code the user attached the necessary hardware sensors and actuators if applicable to the Bluetooth module, launched the wonderment kernel application on the mobile phone, and loaded the XML file generated from the visual programming tool. The kernel reports on the current state of processing for each block of code to aid in debugging the system. While there are numerous improvements to the system that could be made, we were able to produce a working system that allowed visual programming to be used to design and execute software on a mobile phone that provided access to privileged elements of the phone hardware as well as externally attached sensors and actuators.

3.4 Using the Toolkit

Graduate students in an architecture design studio course used the toolkit in final group projects. The course consisted primarily of architecture students with a few information school and computer science students. The final class project involved activating non-places by enabling new civic participation and engagement in student selected public spaces within the local city.

Individual projects involved using pressure sensitive pads, playing audio, sensing motion, triggering lights, *etc*. The final projects were all built using the visual programming tool and mobile phone wonderment kernel. The toolkit worked primarily because most of the interactions were simple to describe such as firing a relay in response to a sound, sensor, or light reading.

We also programmed several basic interactions with the system and demonstrated several of them [27] such as listening for loud noises and calling noise complaint line in response, receiving a SMS message and animating its text on a large LED screen, driving an 120v AC relay and sending an SMS when light levels dropped below a given threshold, monitoring moisture level in a plant's soil and sending SMS messages to users, monitor light levels in a garden, reading accelerometers attached to a skateboard during a "casper stall" stunt and SMSing the results to friends, and taking pictures of red-light runners and uploading them to a server.

One of the observations is that not only does the toolkit reframe the mobile device away from its typical usage as solely a communication tool but endows it with superpowers and supersenses by adding sensing and actuation hardware. It also empowers individuals to build deeply personal systems and those that, in some cases, promote activism. By their nature our mobile technologies are designed to appeal to everyone equally but to no one deeply. The objects of wonderment toolkit is a deliberate design tactic to embrace exactly these deeply personal experiences through the sentiment of personal building and making. For example, how does the design space of mobile technologies evolve once we begin to ask what small groups desire from their mobile technologies such as urban gardeners, skateboarders, disabled people, dog walkers, bike messengers, *etc*. Our approach is not to produce the typical single killer application for thousands or users but to force a new question – what is the design territory of the thousands of deeply meaningful personal applications built for and by smaller groups within our communities?

Figure 4: Images of selected final projects from the architecture design studio class where the wonderment toolkit was used by several students to built interactive public experiences for promoting wonderment.

Our aim is to provide our mobile phones with new senses and abilities by enabling a wide range of physical sensors and actuators to be easily attached and visually programmed by non-experts. We can envision a future where "sensor blister packs" (*i.e.* UV, lead paint, carbon monoxide, pollen, pesticides, accelerometers, *etc*.) not unlike those used for pills contain low cost commodity sensors that are designed for easy integration with small mobile devices. We are participating in the onset of this experience by explicitly researching the design and interaction of such system with mobile devices.

In the second half of the paper we develop a methodology for brainstorming novel public, urban objects of wonderment and demonstrate a fully constructed and deployed system based on urban sounds and ringtones called Hullabaloo.

4. DESIGNING FOR WONDERMENT

To complement the development of the physical toolkit described in the previous section, we present a series of lightweight, provocative, interventionist style techniques for inspiring and developing ideas for future objects of wonderment. If we imagine new public urban objects, what should they do, how should we interact with them, and what is the resulting experience? Our example focuses on the exploration of one such public object designed around public urban sounds and ringtones.

4.1 Listening to Our Public Landscapes

Inspired by the urban probes methodology [28] of deep bodystorming observations, our initial focus was on listening to urban spaces. During these observations, we were drawn to the ubiquity and richness of ambient cityscape sounds [29-31]. This city soundscape was a rich design space and clearly captured elements of wonderment – birds, horns, conversations, *etc*. While some sounds have long been part of the urban sonace such as laughter and crowds, if you listen carefully you will always hear the technology of today's culture dominate. The introduction of the combustion engine radically altered the sounds of cities at the turn of the twentieth century. In fact technology has always played a dominant role in shaping the murmur of our cities. Our modern cities resonate with the sounds of a new technology. During our initial bodystorming activities that were done *in situ* at several outdoor urban locations, it was clear that a new sound had begun to dominate the landscape – ringtones.

Ringtones (also known as ringing tones) are the customizable sounds that can be set to announce incoming calls on most mobile phones. Often a specific ringtone is set for an individual person to announce their call uniquely. While many phones come with a small set of pre-installed tones to choose from, an entire industry has emerged to sell ringtones for mobile phones. Ringtone sales are a $4 billion market worldwide, generating $600 million in the US market alone in 2005 [32]. Some staggering statistics – 95% of US mobile phone users have changed their ring tones, 85% have changed it more than once, and 50% of all mobile phone users in US (age 15-30) have downloaded a ring tone. A key observation is that ringtones have a *private* meaning but are a *public* experience. They are as expressive as the clothing we wear and an obvious extension of what Goffman calls our public presentation of self [33].

Numerous projects have explored the role of sounds, noise, and mobile ringtones within crowds and cities. While not a complete list, we have drawn considerable inspiration from work that promotes new public sounds such as Tejp and Sonic City [34], re-interprets existing signals as audio such as Glitch [35] and Ambient Addition [36], promotes new music making metaphors from ringtones such as Dialtones [37], and new urban sensing strategies such as Noiseman [38]. Similarly, we have been inspired by projects around untraditional collaborative techniques for music composition and expression such as Paradiso's musical instruments [39], Gorbet and Orth's Triangles [40], and Blaine's Jam-O-Whirl Gaming Interface music/sound tabletop [41]. Finally, the public aspects of Benoît Maubrey performances with electro-acoustic clothing and electronically modified everyday objects such as the 1982 *Audio Jackets*, 1996 *Celluar Buddies*, and 1998 *Audio Ballerinas* [42] motivated our approach to design a public urban object. Explicitly avoiding traditional research methods such as user studies, we employed tactics involving public interventions to create lightweight disruptive objects inspired by research into domestic probes [43] and art movements such as the situationists [44]. The goal was to use these intentionally designed provocative objects to direct the brainstorming of the final project around the theme of wonderment. In the following two subsections we describe two such probe deployments designed to deeply explore aspects of human emotions and feelings around urban sounds.

4.2 Sounds Like…Feels Like Tabletop Probe

In the first study our goal was to employ a lightweight interactive public experience to promote an open brainstorm on urban sounds. More specifically, we wanted to formulate an early understanding of how public urban sounds are related to emotion. For example, how do such sounds trigger memories of places, people, and events? We also wanted to insure the exercise would produce a wide range of feedback on urban sounds rather than a game like experience with a narrow focus on specific questions about iconic and easily identified sounds. Further, since we were interested in how the public would share these feelings, we needed to insure that the activity exposed a *public* experience of these captured sound triggered emotions. We also explicitly wanted to avoid a discussion about ringtones or any specific audio technology, opting instead for a sound based stickering and journaling activity (Figure 5). It was also important to run the experiment in an actual urban setting, away from the culturally loaded city center, where it was reasonable to assume people would be willing to engage in a 5-10 minute activity.

Our venue selection was to use two weekend Farmers' Markets where shoppers expect to engage with people, stalls, and performers and our request for participation and time would be more likely accommodated. We chose the Grand Lake Farmers' Market located in the Lake Merritt district of Oakland, California, USA. This is located in the San Francisco Bay Area.

4.2.1 Sounds Like…Feels Like Tabletop Design

Our design choice was to use a circular concentric plot of a selection of places names and contexts extending outward from the location of the study – a circular figurative "map". For example, the actual farmers' market where the participant took the study was positioned at the center of the tabletop map. Concentric rings extended outward from the center to places in the correct compass direction that one could see or walk to from the farmers' market. The outer rings contained names of places of increasing distance such as those that you would drive or, near the edge of the table, fly to. The labeling included iconic Bay Area place names (*e.g.* San Jose) to orientate people with direction, interspersed with generic places, times and activities (*e.g.* park, edge of city, or crowd), and bordered by increasingly distant cities (*e.g.* Houston, London, Beijing). By using this categorization of places people could see/hear, walk to, drive to, or fly, the tabletop graphics are designed to give a quick sense of direction and distance, while suggesting a variety of short contextual descriptions. People were also encouraged to write their own locations directly onto the tabletop. The circular tabletop invited participation from all sides and served as a publicly shared visual log of people's thoughts and experiences of sounds, feelings, and places. The tabletop was also designed to be low enough to allow children to view and participate. While there is a tremendous amount of prior work, on shared tabletop interactions within such fields as computer supported collaborative work, our collaborative tabletop probe is designed to be low tech and does not involve a computer or screen, only an MP3 audio player.

4.2.2 Sounds Like…Feels Like Tabletop Experience

As individuals approached the tabletop they were invited to listen to ten pre-recorded sounds using two provided MP3 players and headphones. Each participant was provided with a sticker sheet containing numbered (and colored) stickers that corresponded to each of the 10 sounds. Individuals could move between the ten audio tracks and were asked to describe as many or as few as they wanted. For each color labeled audio track the participant was asked to write a single word or phrase on the corresponding colored sticker followed by a longer description. Participants were also asked to reflect on each sound and place the sticker geographically on the circular tabletop map (Figure 5).

The ten sounds represented a selection from the iconic and familiar (*e.g.* BART train or ice cream carts bells from the market) to the highly generic (*e.g.* water running or motorway traffic). All of the sounds were intended to leave room for personal interpretation, specifically about imagined context and

Figure 5: The “Sounds Like…Feels Like” Tabletop Study with locations, stickers, and sounds at the Grand Lake Farmers’ Market.

public soundscapes in general. The track list and sound description (which was not provided to the participants) is as follows: (1) Ice cream cart, (2) Rain, (3) Blues singer and sirens, (4) Under freeway, (5) Feet of crowd, (6) Vietnam traffic, (7) Arcade, (8) People talking at an underground BART station, (9) Doorway to Walgreens Pharmacy, and (10) Car Stereo and Skateboarder. All sounds except the Vietnam traffic were recorded and edited within the San Francisco Bay Area by us over a two-day period.

We also wanted to introduce a more free form association of feelings and places away from the pre-recorded sounds we provided. We did this by adding three “feeling stickers” to each sheet of colored stickers and asked people to place the sticker in the direction or location of that emotion for them. There were three labeled “feeling stickers” asking which way and how far away are *comfort*, *fear*, and *adventure*. We also provided one blank “feeling sticker” that participants could fill in and stick onto the table.

4.2.3 Sounds Like…Feels Like Deployment Results

The “Sounds Like…Feels Like” Tabletop was setup at the Grand Lake Farmers’ Market during exceptionally clear weather condition in the Fall starting at 9:00am and running until 2:00pm. This was roughly the full operational hours of the farmers’ market and drew in over 70 participants. Over that entire time period there was never a moment when the tabletop was not being stickered or read by someone. Participants either stepped away from the table to listen to the sounds, filling in all the stickers and returned to place them on the map or they listened to the sounds while looking at the table filling in stickers and placing them on the map one at a time. While one of the goals of the study was to see the discussions surrounding the viewing of others selections, the tabletop did not have enough space to accommodate the volume of stickers over more than about an hour until the stickers began to overlap and occlude each other. For that reason we reset the tabletop with a new map approximately every hour.

While there was much public discussion of the various stickers and comments, there were few stickers placed on the table that directly referenced previously placed stickers. The study, while public in nature, enforced individualism. The task was presented as an individual task, and the headphones enacted a private listening space. Despite the public display of the tabletop, the task itself was introspective and detached in the most part from the social life surrounding the study. The result was a private task in a public space. The tabletop map became a public surface inscribed with an emotional geography of personal and individual stories. When cataloging all of the sound stickers, we were able to cluster them into several themes:

- Mapping to the familiar (*e.g.* generic freeway clatter being labeled as the Bay Bridge)

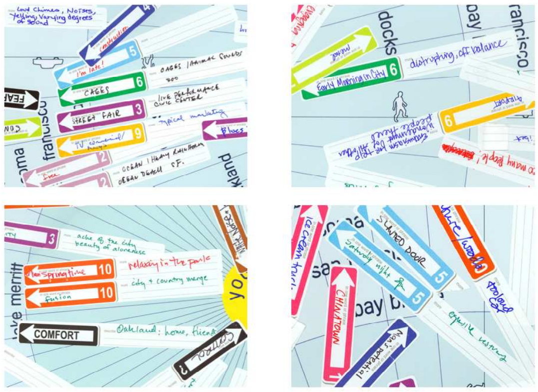

Figure 6: The “ Sounds Like…Feels Like” Tabletop Study summary of several Time and Temporality themed sections of the table: “i’m late”, “time of day”, “seasonal” and “very specific time”

- Evoking memories (*e.g.* ice cream bells described as a specific childhood birthday party)
- Temporality (*e.g.* sounds evoking narratives of times of year, times of day, or specific dates and events)
- Abstract poetics (*e.g.* vivid artistic reflections on happiness with “rain” and frustration with “traffic”)
- Narrative snapshots (*e.g.* fragments of a bigger personal story)

Overall the probe generated insight into the relationship of sounds to individual feelings, places, and directions. However, we wanted to shift the experience by decreasing the private elements and creating more public interactions. We designed our next probe to more directly play into the public interaction and experience of audio.

4.3 Sonic Mix Tabletop Probe

Based on our experience with the “Sounds Like…Feels Like” Tabletop we wanted to insure we would be able to study a more public urban audio experience. We also wanted to understand the idea of publicly created sounds by individuals. Moving more directly toward a discussion about ringtones we asked the question, “What is the nature of a publicly created or owned ringtone?” In some sense a “place based ringtone” created uniquely for that time and place by the people present. Our overall goals for the probe were to (1) increase public interaction and dialogue about urban sounds, (2) explore the range of appropriate and meaningful sound mixes, (3) observe people mix and compose their own sounds without the encumbrance of technology, (4) deepen our knowledge of acoustic aesthetics, (5) gain insight into how a new public sound based object may feel and be experienced, and (6) understand the role of ownership with group composed sounds. Ultimately, we were interested in the question, “How can a community of people initiate and sustain a living, evolving lightweight dialogue using public urban sounds as the vocabulary?

4.3.1 ringtone... what would it be?” When the individual felt theySonic Mix Tabletop Design

As a probe the design needed to be low-fi but functional. Using the same circular table design from the previous probe, we created a Sonic Mix Tabletop. Speakers were mounted within the new table to broadcast sound into the public space surrounding the table. Spaced evenly around the outside of the tabletop were eight knobs attached to potentiometers. An A/D board sent the converted analogue values from each knob to a

Figure 7: The "Sonic Mix" Tabletop using 8 control knobs for mixing public urban sounds.

laptop via a serial link. Custom audio mixing software was written in Processing to calculate and play the correct audio mix. Each knob was mapped to a single sound clip. The sounds were taken from or constructed to represent local sounds (a variety of indoor, outdoor, people, machines, materials, events, times, near, distant, *etc*). Turning a knob past its volume limit shifted sound into increasingly melodic and rhythmic and abstract versions of themselves. These audio distortions were not produced in a systematic way as software might but by exploring different ideas of tweaking audio manually picking out elements of tone, rhythm, *etc*. The knobs were each unique in color and were all labeled with only volume and distort indicators. The formal names for the sounds were *not* labeled on the table. A large red button was positioned near the center of the table. Pressing the button logged the positions of all of the knobs. This was used to registering a user's "vote" for the currently playing sound mix. Immediately after logging the participant's audio choice, the Sonic Mix Tabletop calculated and played the average sound over all of the tallied votes. After 20 seconds the tabletop returning to generating the audio mix based on the current dial positions (Figure 7).

4.3.2 Sonic Mix Tabletop Experience

As people passed by they are asked to comment on the sound coming from the tabletop in various ways including writing comments directly onto the table. They are also invited to modify the sound directly by turning the various knobs. For example, a person could feel that the current place needed more birds, less sirens, and a bit more freeway and then dial those sounds to the desired levels. A single question was posed to drive interaction with the tabletop, "If this place had a ringtone... what would it be?" When the individual felt they had mixed the sound they wanted, they were asked to press the red button, logging their vote.

4.3.3 Sonic Mix Tabletop Deployment Results

The Sonic Mix Tabletop was deployed twice – both times at urban farmers' markets. The first being the San Francisco Civic Center Sunday Farmers' Market and the second a return to the Grand Lake Farmers' Market used in the first probe. In both deployments we included sounds that belonging and signified each of these areas.

On a sunny Winter Sunday from 11:30am until 1:30pm the Sonic Mix Tabletop was deployed at the San Francisco Civic Center Market. During that time 15 people interacted directly with the table by mixing a ringtone. On a milder Winter Saturday from 11:30am until 1:30pm the Sonic Mix Tabletop was deployed at the Grand Lake Farmers' Market in Oakland, California. During that time 20 people actively mixed sounds with the table. We captured a wide range of interactions across these 35 interactions with the tabletop. We illustrate three of these interactions in more detail below.

- Sean, a young male in his mid 20s, commented that personalized ringtones were the "future" and explored the sounds and mixes for 10 minutes with a friend. Sean suggested alternative sounds for the table such as politicians debating in city hall that was visible from the farmers' market, African drums from nearby drummers, and farm animals from the farms at the farmers' market.
- A female in her early 20s declared that she needed to give the mix table "order", labeled each sound with her own descriptive words. We were careful in our initial design for the table to avoid such labeling so that individuals could more personally and broadly interpret the sounds. For example how should we correctly label the sound of water? "ocean"? "fountain"? "drain"? "fishing"? We opted to leave that interpretation to the participants of the probe. However, few undertook this task and in retrospect iconic labels could have been useful in helping people navigate through their sound choices as they mixed.
- Female in her mid 40s generated a small performance as she took temporary ownership of the table and others playing with dials stepped back and observed as she explored each of the dials numerous times and marked each with a pen representing her desired setting. She eventually recorded her mix and then began giving encouragement and advice to others on how to use the table.

Overall the Sonic Mix Tabletop allowed us to explore aspects of shared and collaboratively generated public sounds with people. It succeeded in creating a more public and interactive experience than the previous tabletop probe. It also exposed individual reflections on the types of sounds that should be included and the manner in which they should be mixed. However, there was less joint mixing than we had envisioned. In general people stepped away from the table making room for each other to interact with the knobs on the table one at a time. Multiple people interacting with the mixing dials became the exception rather than the rule. While the probe never delivered the performance of a full scale, real-time multi-person composition tool, we were encouraged by the positive reception to the experience by individuals and their passionate views on urban sounds and places.

5. HULLABALOO

Returning to the original focus for the paper, we used the insights from the two previous probes (Section 4) to motive the design of a new public urban object that promotes wonderment (Section 2) and employs the mobile phone toolkit framework as its core computational element (Section 3). Combining simple Bluetooth sensing technology with a newly fabricated public object, we dynamically generate new urban sonic experiences that reflect the verve of the people that transit it. Each person contributes a unique, personal sound to this place based ringtone mix. This Object of Wonderment is called *Hullabaloo*.

5.1 System Architecture and Design

Just as our Sonic Mix Tabletop performed as a tool to allow the public to participate in mixing a new sound for a place, Hullabaloo uses the nearby Bluetooth signals to mix a dynamic sound for a place. Individual Bluetooth mobile phones that people carry can be wirelessly queried for their unique hardware ID without opening up an explicit communication channel with the device. This means it is easy to discover the devices nearby even if their Bluetooth security configuration is set to refuse connections. More importantly there is no software that needs to be installed on people's mobile phones to make the system work and provide the overall experience. We simply re-interpret each person's unique ID as a sound (Figure

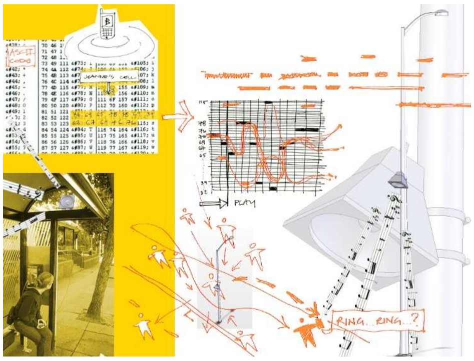

Figure 8 Architectural layout of Hullabaloo reading Bluetooth IDs to generating audio mixes out a speaker.

8). With Bluetooth clearly at the center of many productivity and efficiency task based deployments such as tracking and customer loyalty programs, we envisioned a different use for this technology that promoted wonderment and reflection about life.

The metaphor is for each person to be thought as giving off a personalized and unique sound. As they transit a location, their sound is temporarily mixed with the sounds of others nearby. The result is a public audio mashup driven by the unique collection of nearby people. This "sound of the moment" is unique to others that share that same place during that time. An individual's sound lingers in the audio mix for several minutes after they leave the area and is eventually faded out. Ideally each person would set his or her own personal sound. For example, one person might be a dog barking while another is a doorbell or the sound of someone sneezing. In this form each person can be thought of contributing a unique "sound gift" [45] to the spaces they cross and people they encounter within the city. However, we wanted to deploy a version of the system that would deliver a compelling and collaborative public sonic experience without requiring each individual to partake in a complex audio section procedure for himself or herself. Therefore, each person was deterministically assigned a sound from a collection of several thousand sounds. In the future users could set their sound using a webpage or send their sound directly to Hullabaloo via Bluetooth or MMS.

Using the Objects of Wonderment Toolkit, a mobile phone was placed as the central computational unit and programmed with the visual programming language to generate the desired experience. Using Bluetooth, individual mobile phones are sensed, audio tracks selected, mix levels set, and a small visual output is drawn on the screen. As each Bluetooth ID is located and scanned, its address and familiar name (*i.e.* "Paxton's iPhone") is displayed on the screen of the mobile phone along with its current mix setting (displayed as a progress bar from low to high volume).

The physical design was driven by a requirement that the object not be invisible and fade into the background of urban spaces and that it operate outdoors for months without easily being vandalized, stolen, or destroyed. While such acts are often unavoidable, we have yet to encounter any act of damager or tampering during any of its deployments. The design is also meant to suggest the modularity of the Wonderment Toolkit architecture. That is, that the configuration is a mobile phone with various attachments – in this case a speaker. The result is two custom boxes fabricated from bent sheet metal and powder coated red and white with watertight connectors between them.

Figure 9: Hullabaloo.

The smaller lower box contains the phone with a cutout through which the phone is visible behind a sheet of clear polycarbonate. The other box houses the speaker with a cutout. Since there is no computer or other hardware the two boxes and a single power cord makeup the entire physical system (Figure 9).

5.2 Hullabaloo Deployments

Hullabaloo has undergone several different deployments. It was initially setup for three months in Cambridge, Massachusetts. During this deployment the set of mixed sounds were composed of pre-recorded urban sounds and human activities such as sneezing, laughing, *etc.* Over 10,000 Bluetooth IDs were logged and audio mixed. Informal interviews were conducted with individuals over the course of the deployment. Many recognized their audio signature during regular visits past Hullabaloo. Even more encouraging, several people became curious and wondered who had generated the other sounds they often heard as they passed by. These people speculated who the person could have been by looking around but often felt that the person was not within sight or had already passed. One person specifically described a sound that she liked and had head only a single time and wished that the person it belonged to would return and discover who they were. We would claim that for these people, Hullabaloo promoted exactly the style of curiosity and wonderment about people and urban life described at the onset of our paper.

Another major deployment was made within a downtown setting. In this version the audio samples consisted of unique bird sounds. Therefore each person became, in a sense, a separate bird. As each individual passed by, their bird sound would be mixed in with the sounds of the other birds represented nearby people.

Hullabaloo was also deployed for four days in a park during a weekend long event attended by 40,000 people (Figure 10) and again for three days in suburban area. Again individuals were assigned unique bird sounds. During the four-day 40,000-person deployment, the park offered enough area to install two separate Hullabaloo units – one red and one white in color. Each Hullabaloo unit was setup such that their audio signals did not interfere with each other and neither Hullabaloo could be seen from the location of the other. However, each individual's unique sound was deterministic so as person roamed across the park they would hear the same sound represented for them out of each unit.

The typical interaction was that a person would hear the sound from Hullabaloo and go over to the system to investigate. Once there, they could look into the small box where they saw the name of their phone displayed alongside others. As the bar next to their phone became longer their sound in the mix began to

Figure 10: Hullabaloo deployed outdoors over four days at a park visited by 40,000 people.

dominate and they typically were able to identify it. During the four day deployment many people began to introduce themselves as the one with the high pitched cockatiel chirp or the raspy parrot. One woman apologized to the people nearby claming that she had the most annoying birdcall in the mix but others disagreed and loved it.

Overall, the system became playful and promoted exactly the public reflections, curiosity, and experiences we had setout to explore at the onset of this research. Individuals had little difficulty understanding the rather unique concept of their phone producing a bird sound. This was primarily because of the visual representation of their phone coupled with a progress bar and corresponding output audio. By building Hullabaloo with the mobile phone clearly visible as the central component of the system, we further promoted the concept of the mobile phone away from its typical usage as communication tool and demonstrated it directly serving as a public object with attached peripherals not intended in its original design and marketing.

6. CONCLUSION

What do we *really* desire from our future technologies? We claim that just as in life, they should assist us in solving problems and improving our everyday efficiency. However, we further argue that technology also must prompt us to think, be curious, and wonder. If we fail or, worse yet, ignore this vital design space of wonderment for technology, we are almost certainly doomed to live amongst emotionless, servant-like, lifeless, problem solving, scientific systems. We deserve more. In this paper we argued for pursing a designing for wonderment strategy. We also developed a toolkit specifically designed for encouraging the building and making of new objects that promote wonderment. We fashioned this toolkit around a common, familiar consumer item – the mobile phone. We demonstrated a series of objects of wonderment designed with this toolkit. Finally, we introduced a series of probe style studies in public spaces to initiate a brainstorm around a specific sound based object of wonderment. Continuing with our desire to shatter the perception of mobile phones as primarily communication tools and instead celebrate them in their new role as computational elements for fashioning new objects of wonderment, we describe the resulting system, called Hullabaloo, and summarize several of its longer-term deployments in real life outdoor settings. The major contributions of the paper are (1) to introduce and argue for a technology design territory around wonderment, (2) introduce a novel mobile phone based toolkit designed to promote the construction of objects of wonderment by hacking, re-making, and tapping into the personal DIY passions in each of us, including non-experts, and (3) to demonstrate a design research methodology around the detailed process of designing Hullabaloo, an object of wonderment based on urban sounds and ringtones.

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