SeedMate: Building the Smart Urban Garden

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Figure 1.1 - Rob Faludi, Kate Hartman, Kati London. *Botanicalls* (2006)

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."
- Mark Weiser[1]

At 2:34 pm on a hot afternoon in mid-July, a young professional named Katie received an urgent text message from her tomato plant. "You forgot to water me," the plant complained with the whininess of a needy child. Being three-thousand miles away on vacation, Katie wasn't in any position to quench her plant's thirst so she called her next-door neighbor to ask for a helping hand. Fifteen minutes later, she received a follow-up text from her plant (this time with a more agreeable tone), indicating that she had indeed been watered and now gave her sincere thanks. Without any prompt from Katie and entirely of her own volition, the plant then updated her

[1] Weiser, Mark. "The Computer for the 21st Century." *ACM SIGMOBILE Mobile Computing and Communications Review* 3.3, (1999): 3-11. Web.

status on Twitter, simultaneously broadcasting to the world both her own health and Katie's supposed responsibility and care as a plant owner.

Outfitted with a combination of sensors to measure moisture, temperature, light exposure, and CO_2 levels, Botanicalls is an innovative kit for construction of your own personal "smart garden." Created by a team of artists and technologists at NYU's Interactive Telecommunications Program, Botanicalls utilizes the physiochemical properties of soil, WiFi networks, low-cost sensors, and social media in order to create new communication channels between plants, humans, and technologies. For constantly busy urban dwellers who routinely kill their plants through neglect, Botanicalls offers an attractive task and behavior management system, with reminders delivered in friendly, anthropomorphized form. For those slightly more involved gardeners interested in becoming more attuned to their plant's needs, Botanicalls offers a way to better monitor a plant's vital statistics, providing real-time feedback on its general health. Despite the simplicity of the concept and the ad hoc nature of its original execution, the project has since scaled up, selling thousands of kits and crafting an extensive online presence. It was even featured in MOMA's renowned digital art exhibition, "Talk to Me," in 2011 and was acquired as part of the museum's permanent collection in 2012.

And yet for all of its uniqueness and novelty, Botanicalls is only one of a number of recent DIY experiments working to imagine the future of gardening in urban space. From augmented reality apps to help identify harmful kinds of insects to infrared camera systems for visualizing a plant's circulatory system, there has been an explosion in recent years of technologies aiming to introduce casual users to the urban gardening process. But while designing technologies for the urban gardening space represents an exciting new area of research, it also brings with it a number of specific design challenges. For instance, how can we merge technology with nature, but do so in an unobtrusive and ecologically friendly fashion? How can we use new technologies to help people learn about gardening, while also helping them develop new habits around organic and sustainable practices? How can we create new assemblages of sensors, plants, mobile phones, and social networks in order to facilitate ecologically sound relationships between humans and the natural world? This commitment to rethinking and creating new hybrid ecologies was the exciting problem space from which our project emerged.

RAI and Ubiquitous Computing

In June of 2013, the MIT Mobile Experience Lab assembled an interdisciplinary team of researchers to embark on an experiment which addressed these questions. Led by Dr. Federico Casalegno and collaborating with Italy's premier national broadcasting company, Radiotelevisione Italiana S.p.A. (RAI), the goal of the initiative was to create a platform or tool to support the transmission of knowledge about urban gardening and farming in the Italian context. Rather than take the easy route and simply place informational videos about the topic online, our aim was to create an innovative solution which used *ubiquitous computing* to introduce novice or casual users to multiple stages in the gardening process. Whether they were deciding which seeds to plant on their window ledge, how to maximize returns from small spaces, or how to develop a composting system for a community plot, we wanted our users to consider the entire gardening process holistically through a system that incorporated both physical and digital elements.

Figure 1.2 - Carlo Ratti et al., *Trash Track* (2009)

Coined by Xerox PARC researcher Mark Weiser in his now seminal essay, "The Computer of the 21st Century," ubiquitous computing is a term used to describe a new era of computing after the desktop personal computer of the 1970s and the refrigerator-sized mainframe of the 1950s.[2] Unlike previous imaginations of the computer rooted in an abstract notion of "cyberspace," ubiquitous computing does not pivot on a sharp distinction between digital and physical spaces, but instead works to

[2] Ibid.

integrate them. Seeking to reach beyond the paradigm of bulky, desktop computers tethered to specific locations, ubicomp imagines a world in which technology spills out onto the street and into many aspects of everyday life. As Mark Shepard describes the phenomenon in his book, *The Sentient City*:

> *On any given day, we pass through transportation systems using magnetic strips of RFID tags to pay a fare; we coordinate meeting times and places through SMS text messaging on the run; we cluster in cafes and parks where WiFI is free; we move in and out of spaces blanketed by CCTV surveillance cameras monitored by computer vision systems...*[3]

Thus, whether it takes the form of an RFID tag, a location aware mobile application, or a smart wearable device, ubicomp is concerned with seamlessly integrating the virtual and real world.

While ubiquitous computing acts as a core research interest for the Mobile Experience Lab, it also provides an appropriate framework for approaching urban gardening as a design problem, because ubicomp's diverse subgenres are able to support the multiple ways that people might learn about the gardening process. Consider, for instance, the initial steps a novice gardener might take in planting her first garden. On the one hand, she will need to be introduced to highly technical specifics about soil aeration, ideal spatial configurations for plots, or composting techniques; and many ubiquitous computing genres, from sensors to wearable devices to mobile apps, might be able to support this learning process. However, agricultural education also entails many experiential qualities beyond these pragmatic dimensions. In addition to learning the nuts-and-bolts of various gardening techniques, a good agricultural education might also involve mythologies and local stories learned from your grandmother, age-old traditions and family secrets for how to harvest the best tomato plant, or fuzzy, craft knowledge learned through your hands. Afforded by the increased ubiquity of low-cost mobile phones outfitted with cameras,[4] video production with mobile phones has emerged as an exciting new way for everyday people to tell stories both to their immediate social circles and to the broader public. In this space, mobile-enabled, documentary storytelling has developed as an important ubiquitous computing genre, facilitating the transmission of knowledge about gardening from older to younger generations.

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[3] Mark Shepard, *The Sentient City: Ubiquitous Computing, Architecture, and the Future of Urban Space*. Cambridge: MIT Press. pg numbers.

[4] Joanna Brenner, "Pew Internet: Mobile." *Pew Internet: Pew Internet & American Life Project*. Pew Research Center, 2013. Web. 5 Jul. 2013.

This core distinction, between *experiential* and *pragmatic* approaches to agricultural education, represents the key axis around which this book turns. From the aforementioned mobile video platforms to more experimental sensor projects for measuring plant health, our team is interested in exploring the multiple subgenres of ubiquitous computing and how they might map onto and support these experiential and pragmatic dimensions. Though our team began the research process without a clear cut idea of what would be produced for RAI as a final deliverable, we used this core experiential/pragmatic binary as a scaffolding to structure, drive, and make sense of much of the research that followed. By casting our initial net wide, we hoped to be capacious enough to support multiple learning types in gardening education, and to let our design process truly be led by our emerging understanding of both the target, casual user and the Italian context.

The User-Centered Design Process

[Figure 1.3 - Insert a picture of the whole team]

In order to tackle the complexity of this inherently interdisciplinary problem, we composed a team that was 'quintessentially MIT.' Consisting of students from MIT's departments of Comparative Media Studies, Mechanical Engineering, and Design Computation, our team brought varied skills in graphic design, web development, programming, new media theory, ethnography, documentary filmmaking, circuit building, interaction design and art to bear on the problem at hand. Despite the diversity of our viewpoints, all of these threads coalesced around the core principle of user-centered design – or creating technologies which stem directly from the needs, wants, and limitations of the user. Rather than simply implementing the most high-tech solution, our team sought to truly understand the real world contexts in which our technology would be used. By starting with human needs rather than gadgetry for its own sake, we aimed to create tools that could be seamlessly integrated into the existing social infrastructures of everyday life.

In the interest of abiding by these principles, we divided our design process into a series of overlapping stages. From trend research on experiential and pragmatic approaches in ubiquitous computing to ethnographic site visits with urban gardeners in Rome, Florence, and Milan, we saw each of these steps as inherently connected to one another, each informing the possibilities of the tool that we would eventually create. This series of steps, from trend research and ethnography, to brainstorming and prototyping, constitutes this book's backbone and narrative throughline. However, the myriad trials and tribulations, meanderings and revelations of our story are messy

and human - and therefore, by no means reducible to this process.

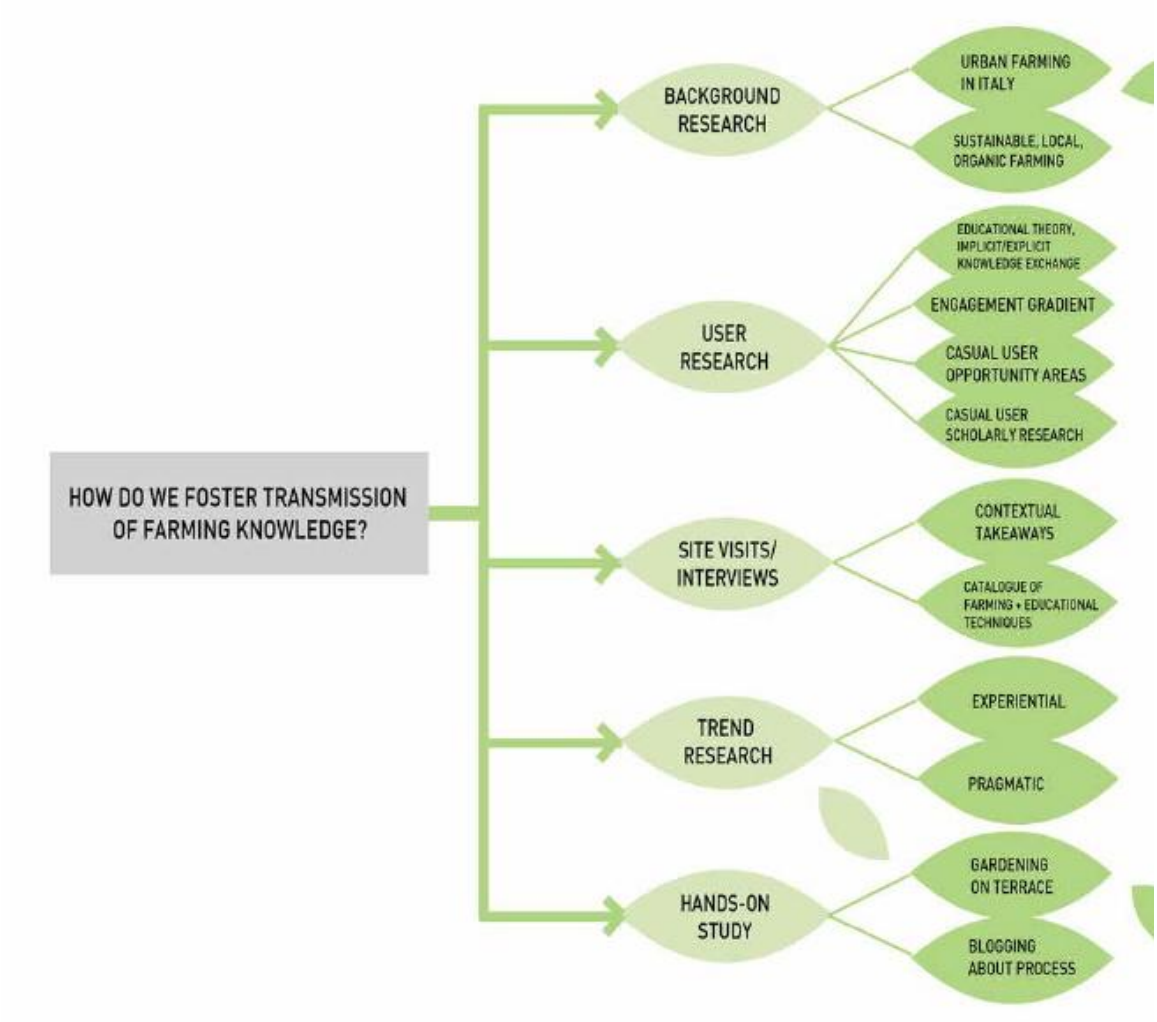

Figure 1.4 - MIT-RAI Team, Research Process Chart

Immediately following this introduction, chapter 2, “History at Hand: Mobile Phones for Documentary Storytelling,” begins our trend research, gathering and reflecting on some of the most exciting new currents in the mobile documentary space. Spanning participatory video platforms, augmented reality projects which embed historical images onto physical space, and location-based storytelling tools, the chapter traces some of the more innovative mergers between documentary and the affordances of mobile technologies. Seeing these emerging trends as part of a longer tradition of personal and historical storytelling in autobiographies, diaries, photo albums, and home movies, we sought to use these case studies to think through how new media (and mobile video, in particular) can approach the past and preservation. While many of the projects showcased in this section are not necessarily about

gardening, many of them do involve intergenerational knowledge exchange, providing us with many pertinent insights into how knowledge transmission happens in the agricultural domain.

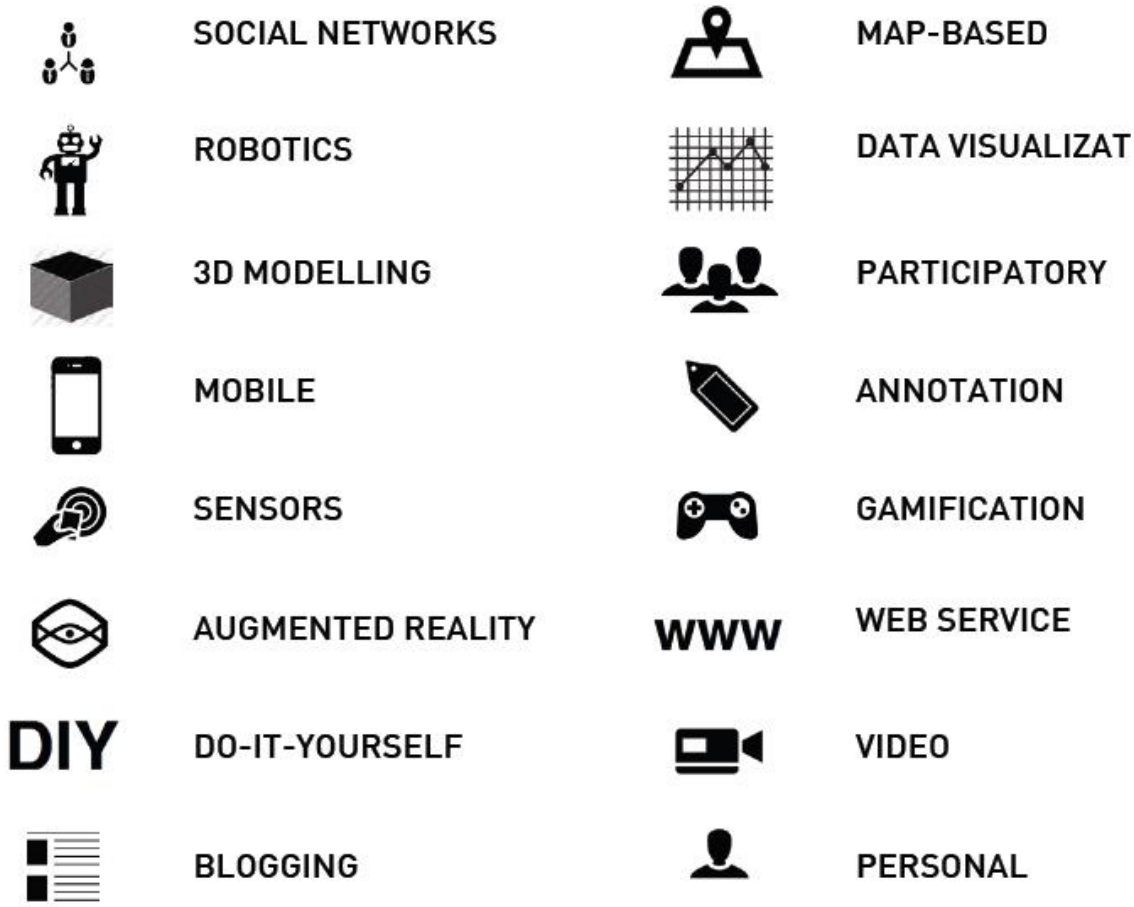

Figure 1.5 - MIT-RAI Team, icons denoting project genre in trend research report

In chapter 3, “Smart Objects: Ubicomp for Pragmatic Learning,” we zeroed in on the ways that ubiquitous computing can support pedagogy pertaining to the highly technical details (or “nuts-and-bolts”) of urban gardening. Taking as its key premise the idea that each genre of ubiquitous computing presupposes its own distinct learning style, the chapter then begins to analyze some of these learning styles and tease out each of their implications for learning about the gardening process. With the question of learning styles in ubicomp as our core theoretical frame, we identified three areas of ubicomp practice of particular relevance to our project: (1) Sensor-based, gamification projects for training; (2) sensors + data viz for systems thinking; and (3) annotation

apps for identification + recommendation. Of course, the goal was not to try and provide some sort of holistic overview of the entire field, but rather to identify those areas most pertinent to our project and to use these precedents as inspiration in brainstorming ideas for our tool.

Ch. 4, “Ethnography for Design: Urban Gardening in Rome, Florence, and Milan,” recounts the story of our ethnographic research at three different field sites in Italy: The American Academy in Rome, the Guerilla Gardeners headquarters in Florence, and the Parco Segentini Association in Milan. In comparison to the previous two chapters which are more theoretical and curatorial in orientation, the ethnography chapter provides a more narrative account of our primary research process, providing the reader with an up-close view of our interviews, hands-on experience working in urban gardens, and reflections and realizations stemming from these events. And yet, despite this general narrative thrust, theoretical questions about how to best conduct ethnography and how to synthesize these insights into “implications for design”[5] are also threaded throughout the chapter. This meta-framing both emphasizes our reliance on user-centered design and underlines the importance of respecting different cultural contexts (Italian, American, or otherwise) in designing new technologies for urban gardening.

Figure 1.6 - Brainstorming session with post-its.

Finally, in Ch. 5, **“**SeedMate: Building the Prototype,” we begin synthesizing takeaways from our site visits in order to begin the brainstorming, concept

[5] This connection between ethnography, user research, and the frequently used industry term “implications for design” is discussed in great detail in Paul Dourish and Genevieve Bell’s *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*. Bell provides these insights based on her long-term position as lead anthropologist at Intel Corporation’s Interaction and Experience Research Lab.

development, and prototyping process. Inspired by IDEO's human-centered design toolkit, our team starts by extracting a series of educational methods, farming techniques, and dream technologies already used by gardening practitioners at the three sites. Using this material gathered on-site and mashing it up against the trend research conducted in the first two chapters, we then begin brainstorming concepts, leaving a cloud of post-its and take-out Chinese food in our wake. The final pages reveal the concept that we actually developed and created, as well as the iterative user testing that we used to refine it. The book then ends on a speculative note, interrogating the relationship between user-centered design and ubiquitous computing, and the difficulties of seeing everyday life as a site for design research.

Disappearing Technologies and the Proximate Future

In their book, *Divining a Digital Future*, Intel Researchers Genevieve Bell and Paul Dourish identify *disappearance* as a driving characteristic and ultimate desire of most ubiquitous computing research. Rather than flaunt their technological prowess, Bell and Dourish argue, ubicomp instead seeks to create interfaces to information which are "natural," "intuitive," and "seamless," fully integrated into the humdrum routines, tasks, and services that make up day-to-day existence. Rather than employ computers which demand environments to accommodate them, ubicomp seeks to create "interfaceless interfaces" in which regular objects are embedded with computational ability. Thus, to Bell and Dourish, ubicomp becomes *infrastructural* - necessary, but invisible, to the functioning of everyday life.

So if ubicomp is truly about technologies that disappear seamlessly into our daily routines, it should come as no surprise that user-centered design and ubicomp maintain a particularly close and special relationship. As a team, we were reminded of this relationship continually through the summer, as understanding the human context for technological interactions often proved to be infinitely more useful than arcane knowledge of Javascript, robotics, microcontrollers, or wireless sensor networks. Learning, for instance, that Italy and the US have a different relationship to the Slow Food movement, became just as important to our design process as did our trend research into different subgenres in ubiquitous computing. Learning, also, that Italian rural and urban farmers exist in a contentious relationship, proved incredibly useful in identifying problems with potential design concepts that were based in dialogue between these two groups. This insistent focus on the existing cultural context of the user grounds our approach to innovation in what Bell and Dourish have called "the proximate future," or a future just around the corner. Rather than focus on high-tech robotics or artificial intelligence, far out visions of alternate virtual realities or other

technologies for technologies sake, the proximate future stems from a subtle extension of the present and an attention to the mundane, tiny details of contemporary life. Ultimately, this book is a reflection of our team coming to terms with those details and crafting new technologies and processes to support them.

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2. History at Hand: Documentary Storytelling with Mobile Phones

Figure 2.1 - Basil Garden at the American Academy in Rome

"No one teaches another, nor is anyone self-taught. People teach each other, mediated by the world around them." - Paolo Freire[6]

My first job out of college, I worked for an immigrant rights organization in Los Angeles called the Institute for the Popular Education of Southern California, or IDEPSCA. In collaboration with researchers from the University of Southern California, IDEPSCA had just created an exciting participatory video platform for immigrant communities called Mobile Voices which allowed anyone with a low-cost mobile phone to capture and upload stories to an online, community blog. As part of the youth and media outreach team, my job was to work with students at a local elementary school to help them create their own stories using the Mobile Voices platform. I was placed in a class of rambunctious fourth graders, many of whom had little to no experience with computers outside of a classroom context and many of whom had no experience with video production.

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[6] Paulo Freire, *Pedagogy of the Oppressed*. 30th anniversary ed. New York: Bloomsbury Academic, 2000. p.18. Print.

One of the first assignments I gave the class was to create a short video about traditions around food in their family. Yesenia, a shy girl from Guadalajara, produced a video about her experience of cooking *pozole* and growing produce in her backyard garden with her grandmother. Yesenia included beautiful ruminations on the happiness she felt when planting chiles with her *abuelita* and how it felt to hold soil in her hands. She recounted how when she was making *pozole*, rather than measuring water in a specific number of cups or tablespoons, her grandmother told her to pour in just enough to reach the second line on her thumb. Throughout the video, Yesenia radiated with the joy of taking ownership over the entire food production process from plot to table and having the privilege of learning this process from her grandmother. Here, Mobile Voices did not necessarily initiate this intergenerational exchange, but at least helped to facilitate and support it in a non-obtrusive fashion.

Yesenia's story reminds us that learning about gardening is a complex process involving the intersection of many kinds of knowledge. In addition to highly technical specifics about the nuts-and-bolts of soil aeration, fertilizer pH levels, or composting techniques, gardening also involves mythologies and local stories, age-old traditions, family secrets, and fuzzy, craft knowledge learned through your hands. These oral stories have perhaps never been written down in a book or formalized into some sort of systematic technique or scientific method. But they remain an incredibly important way for many people to learn about agriculture, and thus represent a key area of research for our team.

Figure 2.2 - Sasha Costanza-Chock, VozMob

If storytelling and tacit techniques remain so important to the intergenerational transmission of knowledge about urban gardening, how can new media be used to facilitate this process? In other words, how can we use technology to preserve memories from one generation to another? While scholars such as Lisa Gitelman have argued that new media by virtue of its "newness" tends to fetishize the future at the expense of history,[7] many recent new media projects have also focused on the past and preservation. Spanning participatory video platforms like Mobile Voices, augmented reality projects which embed historical images onto physical space, or location-based storytelling tools which allow user-generated content to be tethered to specific contexts, the field has seen many innovative mergers between documentary and the affordances of new technologies. Enabled by the increased ubiquity of consumer tools for media production even in low-income communities,[8] the intersection of digital platforms with a documentary impulse has created new forms of autobiographies, diaries, photo albums, home movies, and other forms of personal

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[7] Gitelman, Lisa. "Introduction: Media as Historical Subjects." In *Always Already New: Media, History, and the Data of Culture*. Cambridge: MIT Press, 2008. pp. 1-24. Print.
[8] Jenkins, Henry et al. *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge: MIT Press, 2009. Print.

storytelling.

In the interest of generating ideas for our own tool, this chapter is an attempt to provide an overview of some of the most exciting trends operating at the intersection of new media and documentary storytelling. It showcases many projects which are not necessarily about gardening, but which involve the transmission of knowledge between generations, augmenting the traditional space of documentary with new media potentials. With ubiquitous computing as our frame, we are especially interested in those video platforms which involve low-cost mobile phones in allowing users to create, upload, or accesses stories on the go with relative ease. As mobile phones are increasingly bypassing desktop or laptops as the primary mode of access to the Internet in many parts of the world, we are fascinated by the potential to use this increased access as a means to facilitate everyday participation in storytelling and to augment physical spaces with meaning and history.

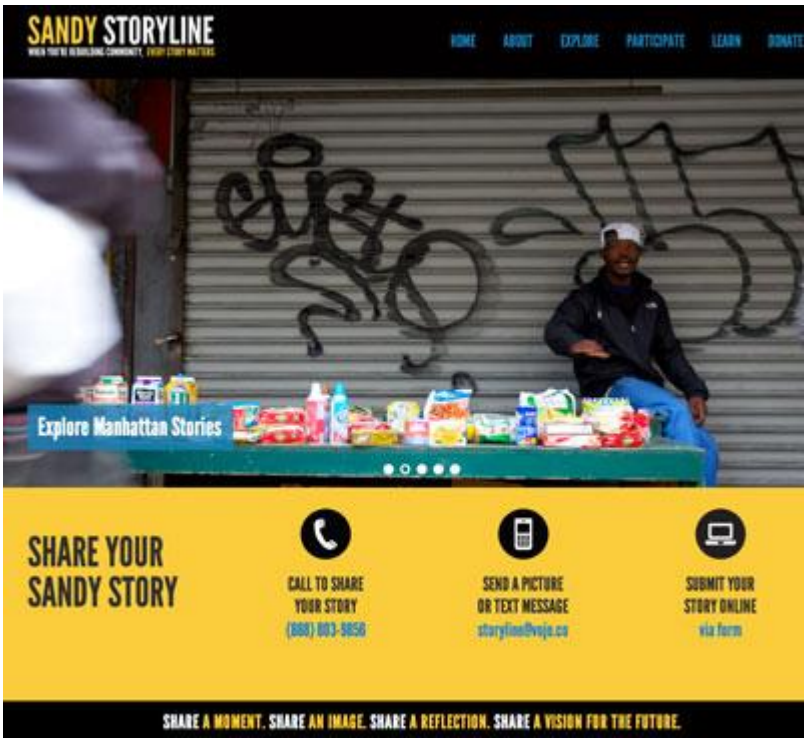
Participatory Video Platforms

If the story of Yesenia's grandmother was powerful in isolation, what might it mean to learn gardening from the collective, online anecdotes of 60,000 grandmothers, all imparting advice about the best way to plant a chile or cook a *pozole*? How might we get these grandmothers to participate in video production of their own accord, especially if they have access to neither technical resources nor tech-savvy grandchildren? In his influential MacArthur Foundation report, "Confronting the Challenges of a Participatory Culture," Henry Jenkins begins to address these questions. Drawing primarily on the experiences of youth engaging in online communities, Jenkins argues that a participatory culture is characterized by "low barriers to artistic expression and civic engagement, support for creating and sharing, and an informal mentorship process, whereby experienced participants pass along knowledge to novices."[9] Alongside likeminded critics like Clay Shirky and Howard Rheingold, Jenkins has underlined the broad cultural implications of such a shift, arguing that if 20th century media ecologies were characterized mostly by an exclusionary model in which only a few professionals could participate, the 21st century is characterized by broader participation amongst everyday people. Spurned on by the increased availability of consumer tools for media production, Jenkins sees this shift as a positive step towards greater self-representation and self-expression, greatly democratizing the practices of DIY media making.

However, to paraphrase the influential sci-fi writer William Gibson, "The future is

[9] Jenkins, pg. 6.

already here, it's just unevenly distributed."[10] As the excited glow from the early days of Web 2.0 has worn off, many scholars have adopted more tempered views which take into account the socioeconomic and cultural differences responsible for unequal rates of participation in digital media production. While lower-income individuals may increasingly have access to consumer grade tools for creating such media, scholars such as Ellen Seiter have argued that simply having greater access to technical resources is not enough. Comparing the development of computer literacies and its accompanying social capital to those associated with playing the piano, Seiter's essay "Practicing at Home" argues that the familiarity that comes through long-term engagement with digital media tools during leisure time is less present in low-income communities, where access to online resources might be found only at school, a public library, or on a mobile phone.[11] Further difficulties are layered in the bias towards so-called "digital natives" in current new media research, which marginalizes the unique experiences of older generations. All of these questions, of course, hold manifold implications for the participatory video genre.



[10] Gibson, William. *Neuromancer*. 1st ed. New York: Ace Books, 1986. Print.
[11] Seiter, Ellen. "Practicing at Home: Computers, Pianos, and Cultural Capital." *Digital Youth, Innovation, and the Unexpected*. Ed. Tara McPherson. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge: MIT Press, 2008. 27–52. Print.

Figure 2.3 - Sandy Storyline website, created with VoJo

If it is easy to see these tensions play out in practically all participatory video practices, it is also clear that the most successful of these projects do not paper over these differences, but instead attempt to take them into account within their initial design. A great example of this is VoJo, an extension of the Mobile Voices project now based at the MIT Center for Civic Media. Like Mobile Voices, VoJo is a hosted mobile blogging platform that makes it easy for people to post stories from inexpensive mobile phones. Offering options to send in media via voice calls, SMS, or MMS, VoJo supports the creation of mini-narratives crafted in text, image, audio, and video. Very much in the vein of other participatory projects like the crisis mapping platform, Ushahidi, VoJo is open source and has been adopted by developers from around the world for a number of different purposes, including advocacy (against domestic violence), grassroots history, and community storytelling (in the traumatic aftermath of Hurricane Sandy). Particularly in the case of the latter, in which hundreds of displaced New Yorkers of all ages and walks of life used VoJo to report their "sandy storylines," there was a sense that the platform became an integral part of the healing process, collecting micro-narratives at the same time that it helped to rebuild a fragmented community.

Figure 2.4 - Image uploaded to Sandy Storyline site, created in VoJo

Since low-income communities are much more likely to have sustained access to low cost mobile phones than desktops or laptops,[12] Vojo builds off of Mobile Voices' low-tech model in remaining committed to the notion of *appropriate technology*.[13] Rather than give into the urge to implement the most high-tech solution possible, by using low-cost mobile phones, VoJo seeks to create a platform flexible enough to fit within the existing technological context of multiple target communities. Thus, despite the simplicity of its concept, VoJo has proven to be extremely popular within its participating communities and has proven its sustainability by having an afterlife far after its initial conceptualizers have left. In contrast to many civic-oriented storytelling platforms, many VoJo instances continue to be rooted in the community-based organization that used the tool, rather than with the academic researchers who initially created the platform.

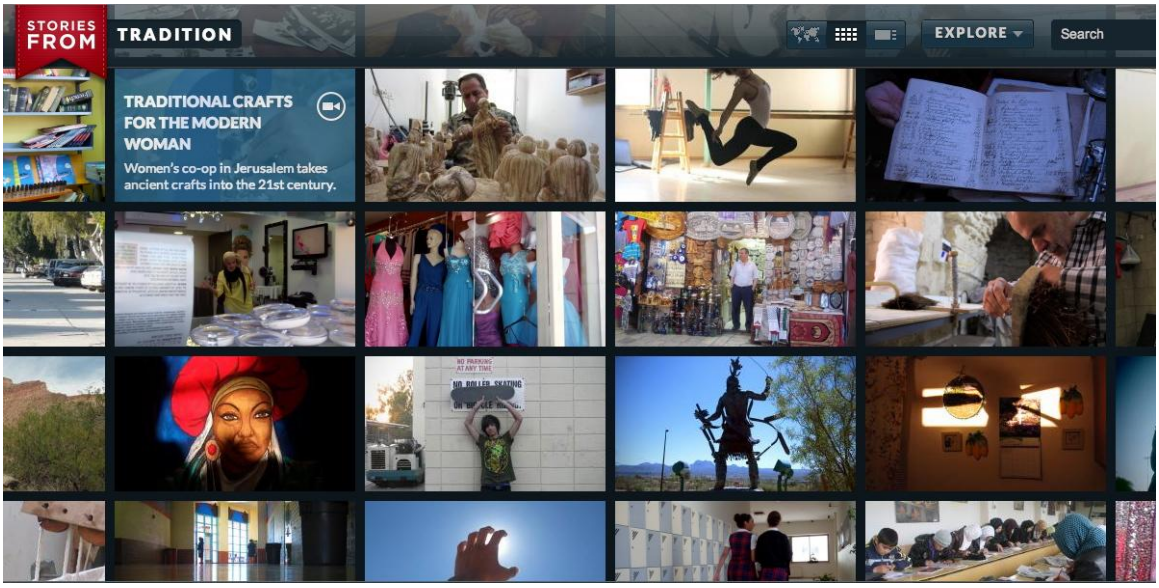


Figure 2.5 - The Tiziano Project, *StoriesFrom* (2012)

Like VoJo, StoriesFrom is a project which seeks to achieve diversity of personal stories through the massive scales of participation that the Internet affords. The winner of an award from the Knight Foundation, StoriesFrom is a both an initiative and a platform that aims to give underrepresented groups a space to shape their own

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[12] Joanna Brenner, "Pew Internet: Mobile." *Pew Internet: Pew Internet & American Life Project*. Pew Research Center, 2013. Web. 5 Jul. 2013.
[13] See Ernst Schumacher, *Small is Beautiful: A Study of Economics as if People Mattered*, London: Blond & Briggs, 1973. Print, for more on the concept of appropriate technology.

narratives. Garnering participation from both documentary filmmakers and professional journalists, the StoriesFrom team works directly with over one hundred communities worldwide in order to train citizen journalists how to use mobile phones to "write, photograph, and video the world around them." Spanning stories from the young Kosovo generation attempting to redefine their identity to testimonials from Native American elders reminiscing about their ancestors' lives before being forced onto reservations,[14] the StoriesFrom project seeks to empower underrepresented groups to tell their own stories.

Beyond its noble mission, StoriesFrom also features an innovative and dynamic interface, providing multiple modes for accessing the same database of information. Users can access uploaded videos through location (via a simple map interface), through themes (which cut across location), as well as through a collage interface which dynamically resizes and arranges videos into what the creators call a "rich digital tapestry." Users can also create their own playlists from the videos, allowing for more personalized trajectories through the global archive. This latter aspect in combination with the sorting by theme, allows for unexpected, transversal connections to emerge, as previously geographically sequestered stories in Bangalore, Edinburgh, and Detroit are woven together in surprising juxtapositions.

From an aesthetic point of view, many of the videos uploaded through VoJo and StoriesFrom are less than perfect. Utilizing consumer grade equipment like cameras and microphones embedded in mobile devices, many of the videos created through these participatory platforms are poorly lit, highly pixelated, or shot with a shaky hand. But if anything the lack of aesthetic quality in these videos connotes the amateur context from which they were born. Seeing the low production quality of these videos does not necessarily guarantee some elusive sense of "authenticity," but rather performs its ordinariness and the wonder of showing this ordinariness to an audience on previously unimaginable scales. Revitalizing the spirit of Fernando Solanas and Octavio Getino's classic essay "Toward a Third Cinema" in a new media context, this aesthetics of poverty evokes a sense of pathos, signalling that ordinary and often marginalized groups of people can impact this new global field of representation and that the small, poignant details of everyday life matter immensely.[15]

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[14] The Tiziano Project. *StoriesFrom*, 2012. Web. 10 Oct. 2013.

[15] Solanas, Fernando and Octavio Getino. "Towards a Third Cinema." In *Movies and Methods. An Anthology*, edited by Bill Nichols, Berkeley: University of California Press, 1976, pp 44–64. Print.

Augmented Reality and Story Rich Objects

Figure 2.6 - Innovative Technology for Innovative Instructors, augmented reality demo

Beyond participatory video platforms, there are many other new media genres taking a more experimental approach to rethinking the documentary impulse to personal storytelling. One such trend is augmented reality. According to Lev Manovich in his essay, "The Poetics of Augmented Space," augmented reality is "the layering of dynamic and context-specific information over the visual field of the user."[16] Whether the interface is "eyewear [like Google Glass], a vehicle's windshield, or simply holding a smartphone up to a building to gather information about the site,"[17] augmented reality is concerned with how the meaning of a physical place can be transformed by the overlay of virtual data. As mentioned previously in the introduction, unlike virtual reality which operates on a strict division between real and virtual worlds, augmented reality posits that these two kinds of spaces can be experienced as a "single

[16] Manovich, Lev. "The Poetics of Augmented Space," *Visual Communication 5.2*, (2006): p. 222. Web.

[17] Farman, Jason. *Mobile Interface Theory*. New York: Routledge, 2011, p. 39. Print.

phenomenological gestalt."[18] As a subgenre of ubiquitous computing, augmented reality imagines physical space as a substrate which can be both "read" and "written to" - allowing users to dynamically access data which augments real world locations, while at the same time allowing them to contribute their own data to physical space as a collective archive.

Up until the early 2000s, augmented reality had primarily been used either as an element of spectacle in science fiction films or for commercial purposes; and though the field has opened up to a much greater variety of different uses for AR, both of these trends remain popular uses for the technology today. One of the most prominent early imaginations of augmented reality was in James Cameron's popular sci-fi thriller, *Terminator* (1984). Used to emphasize the artificial, cyborg vision of the Arnold Schwartzenegger character, whenever the camera goes into his first person point of view, the visual field is overlaid with "computer readouts, diagrams, graphics, flashing cursors, and scrolling text."[19] In another prescient scene from Steven Spielberg's *Minority Report* (2001), Tom Cruise's character walks into a GAP store and a personalized, interactive billboard overlays his visual field, recognizing him, referring to him by name, and asking him how he is enjoying the shirts he purchased last week.[20] In both cases, augmented reality connotes a cold and inhuman point of view, in which the entire field of vision is reduced to that which can be analyzed. Here, as in real-world, location-based applications which allow users to access price information by pointing their camera phone at an object, the world is reduced to a blunt, Cartesian grid, wholly knowable by objective metadata.

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[18] Manovich, p. 222.

[19] Very much in the same vein as Terminator, other films of the same science fiction films of the same era such as Paul Verhoeven's *Robocop* (1987) and John McTiernan's *Predator* (1987) use visual effects like cross-hairs and thermal imagining to suggest the merging of the eye of a villainous character with computer vision. See Alexander R. Galloway, *Gaming: Essays on Algorithmic Culture*, p. 53 for more on this phenomenon.

[20] See Gordon, Eric and Adriana de Souza e Silva. *Net Locality: Why Location Matters in a Networked World*. Hoboken, NJ: Wiley-Blackwell, 2011. Print. There is also a very similar scene in David Fincher's *Fight Club* (1999) which imagines an augmented reality like scenario in a commercial setting. As the Edward Norton character describes how his life has become stullifying and mundane IKEA furniture, prices pop up over each of the furniture items in the frame, effectively annotating the visual field with metadata. See Steve Anderson, "Fight Club Ikea Catalogue," for a short analysis of this scene.

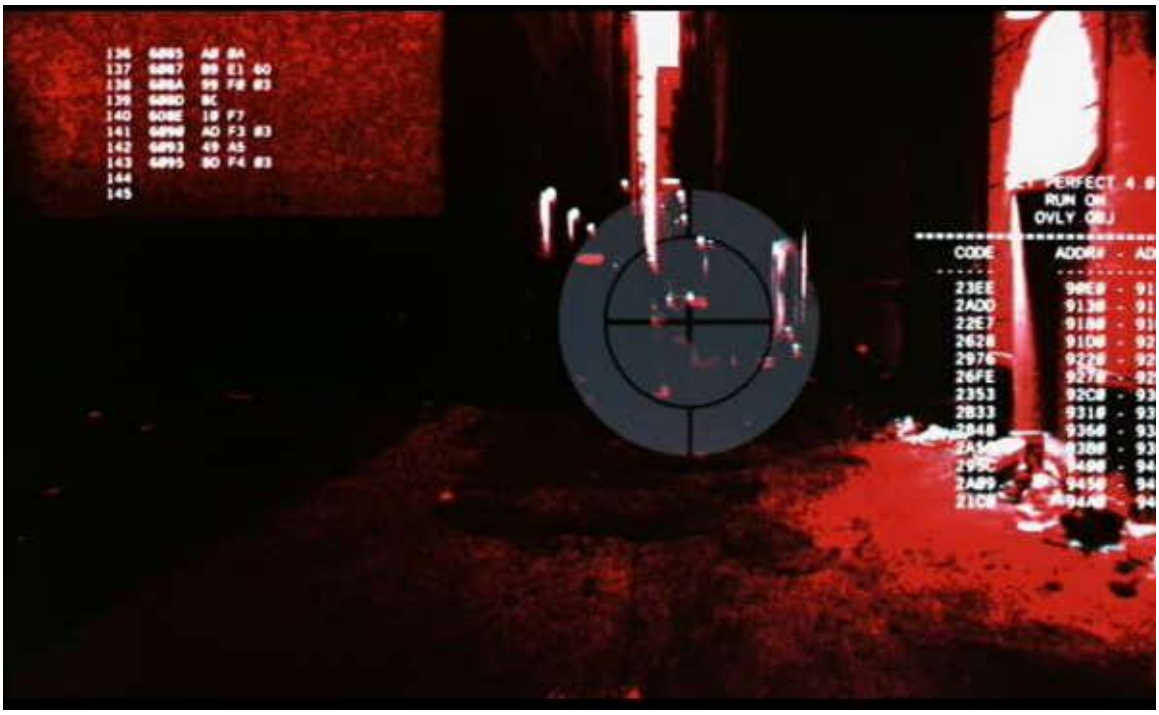

Figure 2.7 - James Cameron, *The Terminator* (1984)

But if augmented reality has historically been associated with cold, machinic, banal, or commercial perspectives, what might it mean to imagine AR serving more poetic uses? How can it be used to preserve historical memory or facilitate personal storytelling? One stunning example of this alternative use is the StreetMuseum application created by the Museum of London. Released in 2010, StreetMuseum allows users to utilize their phone's camera to access historical photographs overlaid onto the physical landscape of the city of London. Based on your GPS location and the direction that you are facing, the application allows you "to juxtapose images from the past with current surroundings,"[21] while also accessing metadata and captions associated with the historical photographs.[22] In his book, *Mobile Interface Theory*, Jason Farman has a beautiful passage describing his use of the tool at 23 Queen Victoria Street, the former site of the Salvation Army International Headquarters, which was destroyed in a night raid by the German army on May 10th, 1941. Now replaced by a hair salon and a coffee shop, using StreetMuseum at that historic location and seeing the disjunction between past and present spaces evokes what Roland Barthes

[21] Farman, p. 40.
[22] HistoryPin is another application with very similar affordances for overlaying historical photographs onto an image of present day space. However, unlike StreetMuseum, HistoryPin allows users to upload their own photographs, instead of just access those officially sanctioned by the museum.

has called the *punctum*,[23] or the poignancy that comes with witnessing the passing of time in photography. Literally meaning "the detail which pierces" in Latin, the *punctum* for Farman comes in witnessing the crumbling rubble of the historic site juxtaposed with the commercialism of its present manifestation, and the pathos evoked in that disjunction. Stemming from his situatedness in that specific location at that specific time, Farman's experience of using StreetMuseum at 23 Queen Victoria Street gives context, meaning, and multi-dimensionality to the contemporary physical site, transforming space into *place* - a truly embodied location.

Figure 2.8 - Museum of London, *StreetMuseum* (2010)

Another interesting use of AR for storytelling is *Barcode* (2011), an experimental documentary for both web and mobile platforms created by the National Film Board of Canada. Soliciting the participation of both professional video artists and amateur filmmakers, *Barcode* is an online documentary project and app that allows users to access and create stories for everyday physical objects. Simply by scanning a barcode on an object with an iPhone, a one-minute video art piece associated with that object (or the object's larger thematic category) is shared with the user. The user can also contribute their own stories to the object database, allowing each object to be

[23] See Roland Barthes, *Camera Lucida: Reflections on Photography*, for more on the *punctum*.

embedded with multiple meanings.

Barcode is effective in its use of augmented reality for the purposes of documentary storytelling because it understands the ways that objects can become imbued with personal significance. For instance, in one video associated with a loaf of bread, the filmmaker, Julie Bonan, tells a deeply personal story about the tradition of Passover in her family and how all remnants of bread, from entire loaves to the tiniest crumbs, must be expelled from Jewish households in respect for the holiday. While to other filmmakers in the database, bread might conjure up memories of summer picnics and deli sandwiches, to Julie the image of bread reminds her of its absence, and the importance of this absence to her Jewish heritage. In another video associated with a ring, the filmmaker, Cedric Chaubal, describes his emotional attachment to a cheap, tin band that his mother bought for him at a flea market when he was a child. Although he never used to wear the ring before, he now will never take it off, as she just passed away last fall.

Figure 2.9 - National Film Board of Canada, *Barcode* (2011)

While the very notion of a barcode seems to suggest that every object can be reduced to its economic worth, *Barcode* resists this reductionism, demonstrating that rich memories can lie below the surface of objects. Almost parodying the crass commercialism of most AR projects, *Barcode* argues that, even though an object might be standardized and industrialized, each use of that commodity is unique and holds wildly varying personal significance for each owner. Thus, for Julie Bonan and for other orthodox Jewish families, a loaf of bread means something entirely different than to Presbyterians or Sunni Muslims. Cedric's tarnished tin ring from his mother may be invaluable in his eyes, but it will mean almost nothing to any individual not familiar with his story. In each case, augmented reality provides the medium in which the surface of everyday, tangible objects are layered with multiple dimensions. Recalling Michel de Certeau's distinction between strategies and tactics in his classic text, *The Practices of Everyday Life*, the stories delivered through AR provide oppositional, tactical appropriations of objects in space, reclaiming commodities from their official readings and imbuing them, almost against the grain, with personal significance.[24]

Mobility / Orality

Figure 2.10 - National 9/11 Museum, *In-Situ* (2011).

[24] Michel DeCerteau, *The Practice of Everyday Life*. Trans. Steven F. Rendall. Reprint ed. Berkeley: University of California Press, 2011. Print.

In his book, *Orality and Literacy: The Technologizing of the Word*, Walter Ong famously contrasts oral and literate cultures.[25] Underlining the ways that the invention of writing as a technology initiated an epochal shift, Ong argues that oral modes of knowledge transmission have unique properties that make memory operate differently than under writing-based regimes. For Ong, pre-literate, oral societies rely on repetition, mnemonic devices, liveness, and highly vivid storytelling in order to pass on memories and traditions from one generation to another, in contrast to written societies which require thought to be solidified into a static, external object outside the mind (a book). For some, including Socrates, the intergenerational transmission of knowledge through oral means represented the foundation and highest achievement of any society, with writing operating as a mere shadow in comparison.[26]

Of course, oral traditions and histories continue to operate as an important mode of knowledge transmission across the world, both in industrialized and developing societies. But what might it mean when this oral tradition merges with the affordances of the mobile phone? How might the cultural practices of impulsive documentation through mobiles (pictures on Instagram, incessant updates on Facebook) be related to the more primordial desire to document personal experiences into collective cultural memory? The key strengths of the contemporary mobile phone as a medium -- greater affordances for personal media making and a deeply ingrained sense of location-specificity -- are beginning to facilitate a sea change in how everyday citizens are beginning to view the places which they inhabit. Being able to pass down personal stories from generation-to-generation in video form, but also upload these story to a large repository on the Internet as in Mobile Voices or StoriesFrom, allows everyday people to bring their home movies or video diaries out of the basement and into the realm of collective memory and public life. Being able to annotate an urban space with a personal photograph or a hidden history, as in StreetMuseum, imbues that location with new meanings and reclaims the space for its inhabitants. In this age of what Marshall McLuhan and Ong have called "secondary orality," new media is revitalizing many aspects of oral tradition (a dialogic quality, liveness, presence), but

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[25] Ong, Walter. *Orality and Literacy: The Technologizing of the Word*. 2nd ed. New York: Routledge, 2002. Print.

[26] See Plato's *Phaedrus* for Socrates' infamous denunciation of writing as an 'inhuman' technology, which he feared would destroy the brilliant memories of oral storytellers. This quote is particularly apt: "Writing will implant forgetfulness in their souls; they will cease to exercise memory because they rely on that which is written, calling things to remembrance no longer from within themselves, but by means of external marks."

with the storage and posterity characteristic of print media. And with mobile phones in particular, the space of everyday life is becoming the vibrant archive of that collective memory, with a simple handheld device acting as the guide to that precious information.

Ch.3 - Smart Objects: Ubicomp for Pragmatic Learning

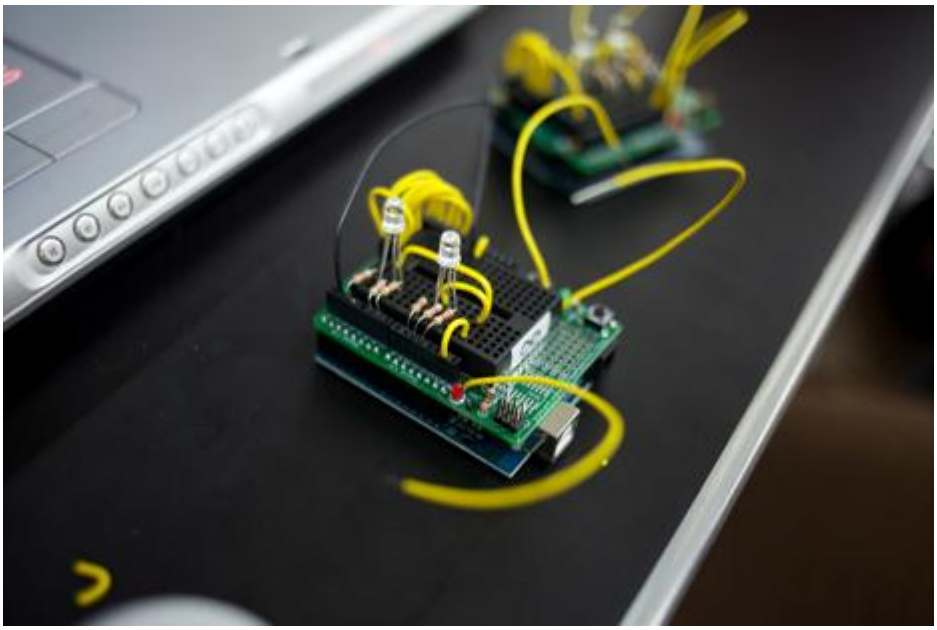

Figure 3.1 - Living Architecture Lab at Columbia University, Amphibious Architecture project, "Network of Microcontrollers"

From smart phones to smart appliances, smart jewelry to smart furniture, intelligence is a virtue that seems to be embedded in many objects that fall under the umbrella of ubiquitous computing. But what does it actually mean for an object to be "smart"? And how might this intelligence create a feedback loop of knowledge and information now aimed at the user, who can use these smart objects to support his or her educational process?

According to Mike Kuniavsky in his book, *Smart Things*, a defining characteristic of ubicomp objects is what he calls an "information shadow."[27] Comparing the phenomena to J.M. Barrie's *Peter Pan* (1914), in which Wendy sews a shadow to the titular protagonist's feet, Kuniavsky argues that an information shadow attaches the immaterial to the material, linking digital information to physical objects. Pointing to the decreased cost and wide accessibility of RFID tags, QR codes, SIM cards, and magnetic stripes, Kuniavsky notes that creating an information shadow for an object is now easier than ever, and has seen a proliferation of uses in recent years. Although the earliest uses for information shadows were utilitarian and economic in nature (for instance, product tracking in the postal service and barcodes at the grocery store),

[27] As Kuniavsky briefly notes, the use of the phrase "shadow" to describe the relationship between a physical object and digital information has a long and rich history. Although a similar use of the concept can be seen in Greenfield's book, *Everyware: The Dawning Age of Ubiquitous Computing* (2006), the phrase "data shadow" was used as early as 1967 in Westin. See Kuniavsky, Mike. *Smart Things: Ubiquitous Computing User Experience Design*. Burlington, MA: Morgan Kaufman, 2010. Print.

socially-oriented versions have increasingly made their way into both commercial and non-commercial contexts. For instance, when connected to the Internet, social metadata about the way an object has been "reviewed, discussed, photographed, mocked, praised, prodded, measured, disassembled, and hacked" can increasingly be put into conversation with the metadata of other objects.[28] As the network of objects grows and eventually reaches critical mass, the information shadows of multiple objects begin to form a kind of collective intelligence. As more smart objects are added to the network, the possibilities for mass customization of experiences based on recommendations also increases exponentially. Here, the aggregation of information shadows creates a kind of vibrant social life and intelligence from the conversations about and amongst "smart things."

While the benefits of attaching information to physical objects is by now well established in industry, its benefits for learning have been grossly underexplored, especially in relation to agriculture. Although the previous chapter explored the ways that gardening consists of fuzzy knowledge, best learned through storytelling and intergenerational exchange, urban gardening can also be seen scientifically as a kind of *complex system* involving the interaction of multiple parameters. Successful urban gardeners must not only be able to identify pertinent species of plants, but also juggle highly technical knowledge about a plant's sunlight and shade requirements, water needs, and appropriate fertilizer pH levels. Rather than simply putting any old plant on a window ledge, urban gardeners must also consider ideal spatial configurations for plots, what plants grow well together, and what bugs might benefit or harm a garden. Being able to combine and tweak these parameters so that they maintain an equilibrium requires much skill, a sense of proportion, and a wide catalogue of encyclopedic knowledge. Thus, because gardening is essentially algorithmic and combinatorial in nature, bearing more than a passing resemblance to an information science, ubicomp seems particularly well-suited to support learning in this context.

[28] Kuniavksy, "Ch.6 - Information Shadows," pp. 69-87.

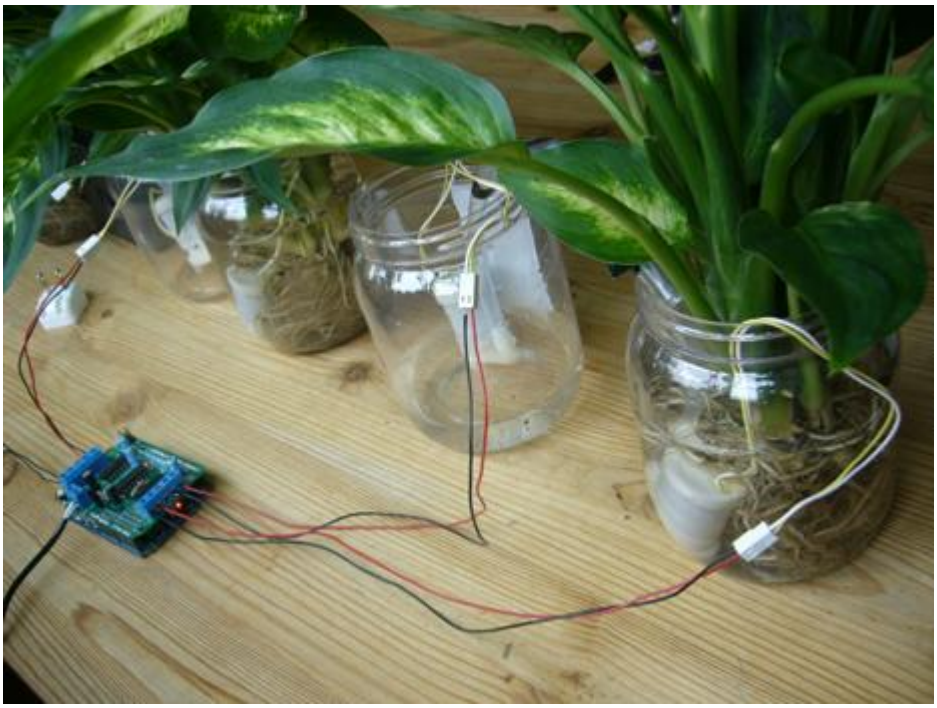

Figure 3.2 - Usman Haque et al., *Natural Fuse* (2009)

This chapter will explore some of the pedagogical benefits of ubicomp through a number of case studies, focusing on the ways that it can support learning about the pragmatic aspects (or "nuts-and-bolts") of urban gardening. Although it covers a number of ubicomp genres, from sensor-based projects to identification apps to location-based social games, the chapter is much more interested in the question of *learning style* and the kinds of knowledge production that such technologies are able to support. For instance, how might a ubicomp system *train* a user to take care of a plant at specified intervals, allowing her to become more attuned to a plant's wants and needs? How might an information shadow allow a user to *interrogate* where their vegetables come from and understand the production infrastructure that brought her tomato from field to table? How might a smart device allow a user to *identify* good and bad insects by dynamically accessing metadata contributed by other users through a camera phone pointed at a plant? These and similar issues are the kinds of questions that we wish to explore.

Sensors + Gamification for Training

Coined by Wired Magazine in 2007, the term "quantified self" refers to a movement amongst technologists to incorporate ambient data collection into everyday

life.[29] Focusing primarily on physical vital signs such as oxygen levels, heart rate, blood sugar levels, and calories consumed, the quantified self movement uses a variety of wearable sensors (EEG, ECG, video) for the purposes of monitoring and thereby improving everyday behavior.[30] Seeking to "increase self knowledge through self-tracking," the core goal of quantified self is to use auto-sensing technology to make users aware of the choices that affect their health. Although such continuous and ambient self-surveillance might cause devotees of Michel Foucault to cringe,[31] proponents of the movement say that such monitoring has improved their daily functioning and ultimately their overall well-being.

We can see many echoes of quantified self in the wide variety of sensor-based projects dealing with urban gardening and ecological sustainability. In the Arduino-based Botanicalls (which we glossed briefly in the introduction), the project uses sensors to measure moisture, temperature, and other physiological aspects of plant health. That data is then translated into human readable form through information visualizations and friendly tweet and text reminders, with the goal of helping humans to become more attuned to their plant's physical state. But beyond simply increasing interspecies communication, Botanicalls also promotes time management skills necessary for a garden's care. By encouraging the user to water a plant at regular intervals and by making the user's record of care public (potentially embarrassing her should she be a neglectful owner), Botanicalls teaches responsibility through behavioral regulation, "training" the user through a combination of time management and social shaming.

In the structurally similar Tweet-a-Watt project, an electricity monitor and XBee radio microcontroller post a user's hourly electricity use to Twitter. Here, as in the Botanicalls project, Tweet-a-Watt plugs into any wall or device socket, allowing the user to gain self-knowledge about her energy use and broadcast that information to the greater world. However, in an extension of the sociality surrounding Botanicalls, Tweet-a-Watt participants have gamified their energy usage by creating competitive leader boards online. In these online forums, Tweet-a-Watt players receive points for reducing their energy usage and can set goals for themselves or compete against other players in trying to achieve the most sustainable home. So while the sensors are no longer affixed to human bodies as in the case of the quantified self movement, the idea

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[29] "Quantified Self." *Wikipedia: The Free Encyclopedia.* Wikimedia Foundation, Inc., 9 Oct. 2013. Web. 1 Oct. 2013.
[30] Ibid.
[31] Foucault might call this kind of internalized self-regulation through surveillance "discipline" or "care of the self." See Foucault, Michel. *Discipline & Punish: The Birth of the Prison*. New York: Vintage Books, 1995. Print.

in both Botanicalls and Tweet-a-Watt are clearly the same. By gathering feedback from sensing technologies, users hope to better monitor and eventually manage and change their own behavior.

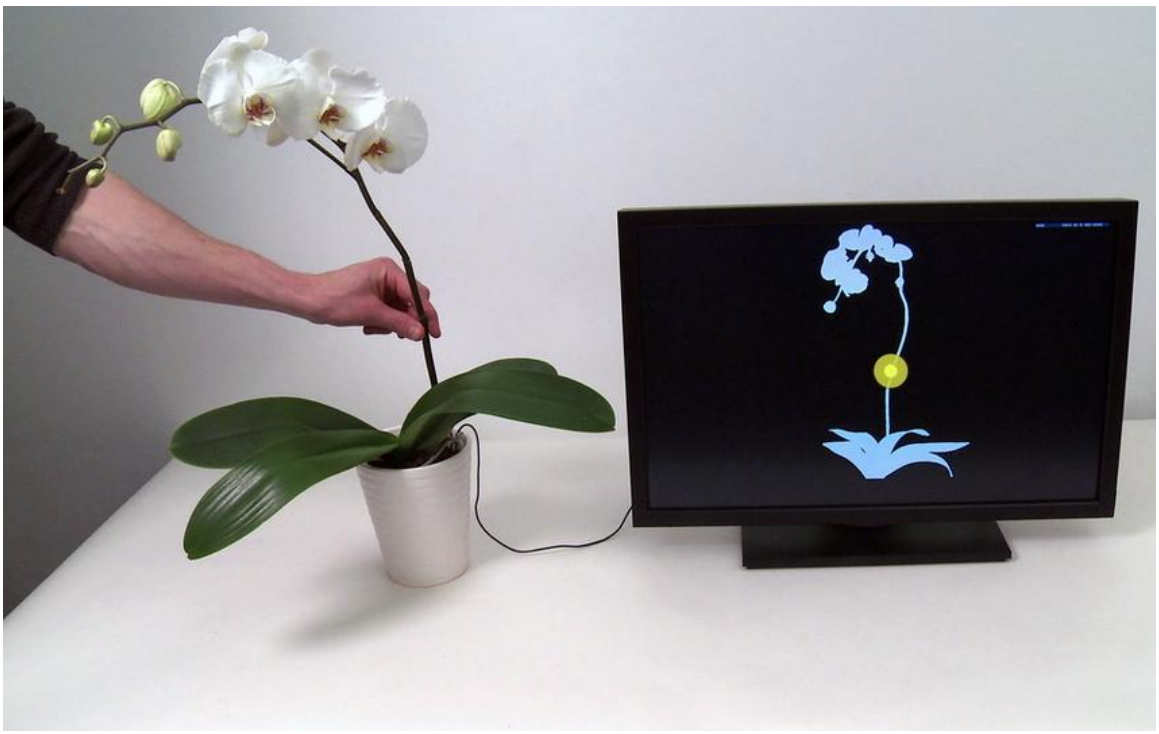

Figure 3.3 - Disney Research (Pittsburgh), *Botanicus Interacticus* (2012)

Botanicus Interacticus, a project coming out of Disney's Research Lab in Pittsburgh, also incentivizes responsible behavior, but in a much more expressive, almost sculptural interface. Attaching electrode sensors to a plant's leaves, roots, and stems, the project visualizes a plant's health through an abstract, but still avatar-like representation of the electricity circulating through its system. Comparing Botanicus Interacticus to "virtual pet simulators" like Tamagotchi, the project's creators use the avatar to encourage plant owners to water and care for their plant on a regular basis. When a physical plant has been watered and well cared for, its avatar representation exfoliates, growing tall and branching off in multiple directions; when it has not been well cared for, the avatar sheds its leaves, shrinks, and diminishes. Thus, in an extension of the Tamagotchi concept, the physical plant is directly related to its virtual representation, incentivizing the care of a real, living thing by connecting its well being to the growth of a virtual counterpart.

Although some critics such as Ian Bogost have critiqued gamification for the

ways that it relies on an educational model of stimulus and response,[32] various university research labs, start-ups, and design firms have continued to find successful ways to connect this strategy to sensor-based systems. For instance, the field of gamification for exercise, which frequently employs wearable computing for monitoring vital signs, has exploded in recent years, as have ubicomp systems for physical therapy and other medical contexts. However, sensor-based learning for agricultural education remains a comparatively underexplored area. Because care of a plant requires the cultivation of discipline and time management skills in a user, sensor-based, gamification systems represent an extremely fertile area of inquiry, fostering the discipline required for maintaining one's own personal garden.

Sensors + Data Viz for Systems Thinking

Beyond projects like Botanicalls and Tweet-a-Watt which encourage regulation of individual behavior, there are many other sensor-based works which deal with increasing awareness of large-scale, infrastructural problems. One such project is the brilliant Trash Track experiment, which came out of the MIT Senseable City Lab in 2009. At its core, Trash Track embodies an incredibly simple concept - "to understand where our garbage goes once it has left our sight." Using cheap electronic tags enabled with GPS, the Trash Track researchers placed these tags in individual pieces of trash, dispersed them throughout cities on the east and west coast of the United States, and observed their movements over time. By connecting this ambiently collected data to dynamic, real-time maps and data visualizations, the goal was to track how far pieces of trash traveled, thereby making visible the efficiency of urban waste management systems. While this and other urban infrastructures are usually "ubiquitous" and "inscrutable," the Trash Track project seeks to make this information available and generally more legible to the broader public.

[32] Bogost, Ian. *Persuasive Games: The Expressive Power of Video Games*. Cambridge: MIT Press, 2010. Print. In this book, Bogost launches an extended attack on gamification and exercise, connecting it to the tradition of behavioral psychology; and in particular, the work of B.F. Skinner.

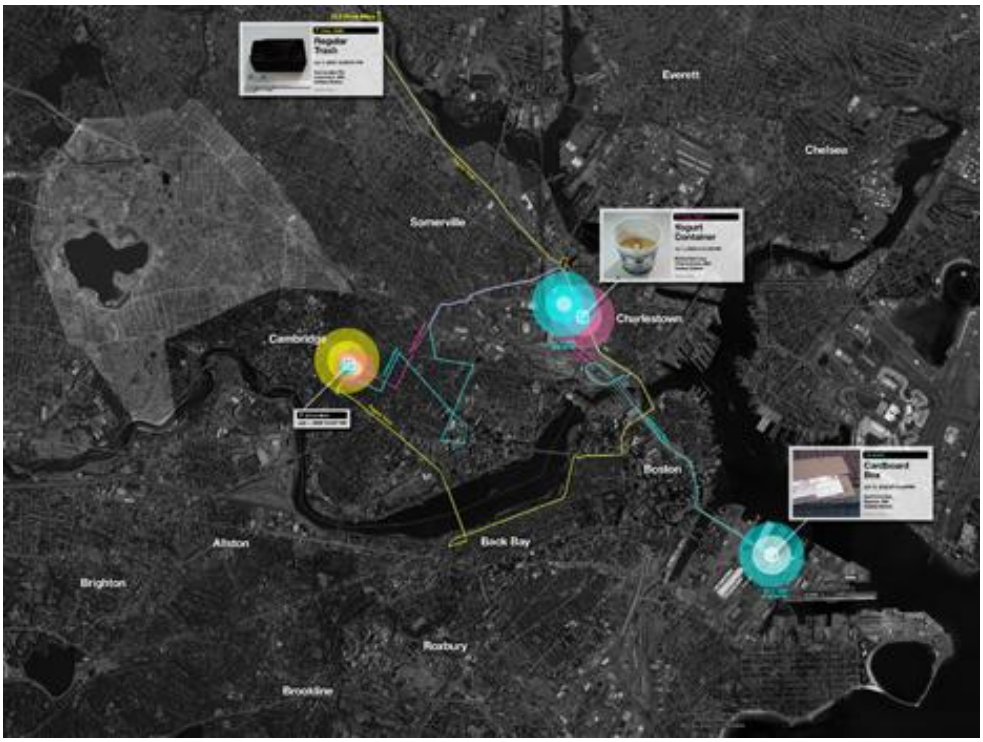

Figure 3.4 - MIT Senseable City Lab, *Trash Track* (2009)

In his essay on the project in the collection, *The Sentient City*, Dietmar Offenhuber begins to outline some of the complexity of these urban waste management systems. Describing the afterlife of trash when a landfill reaches capacity, Offenhuber traces an elaborate network of "transfer stations, landfills, and reprocessing plants" working in combination with "trucks, trains, boats, and planes," adding that the network can become even more complex when "rerouted by regulations and markets." Connecting these insights to the Trash Track project, he recounted the story of a woman's old shoe, which was one of the first objects to be tested with a sensor, and how it traveled over 300 miles from Seattle to Portland and back up again to a landfill near the Washington/Oregon border. When the cost of moving excess trash like the shoe is correlated with the rising cost of fuel, Offenhuber argues it is clear that sending our trash away from the city for disposal is increasingly unsustainable.

By making the distance traveled by trash visible, Trash Track seeks to understand how well this infrastructure functions, and in much the same way as Botanicalls and Tweet-a-Watt, encourage individuals to manage their individual behavior. But, for this project and many others dealing with urban infrastructures, the question of *scale*, and more specifically toggling between the local and the global, emerges again and again as a unique conceptual focal point. For Offenhuber, his

ultimate goal was to demonstrate how this information "could inform infrastructural planning at the city, regional, or international scale, as well as trash disposal decisions at the individual, human scale…"[33] And in a survey handed out to project participants, one volunteer hoped that Trash Track would help her "bridge the gap between my consumer choices and making the planet a little cleaner."[34] This idea of helping to eliminate "the gap" by showing the ways that individual human choices aggregate and scale up to large scale, ecological problems situates personal stories within a complex system. It allows users to garner a larger, systems level understanding of usually invisible infrastructural phenomena while at the same time seeing how their everyday actions have real impact in the larger world.

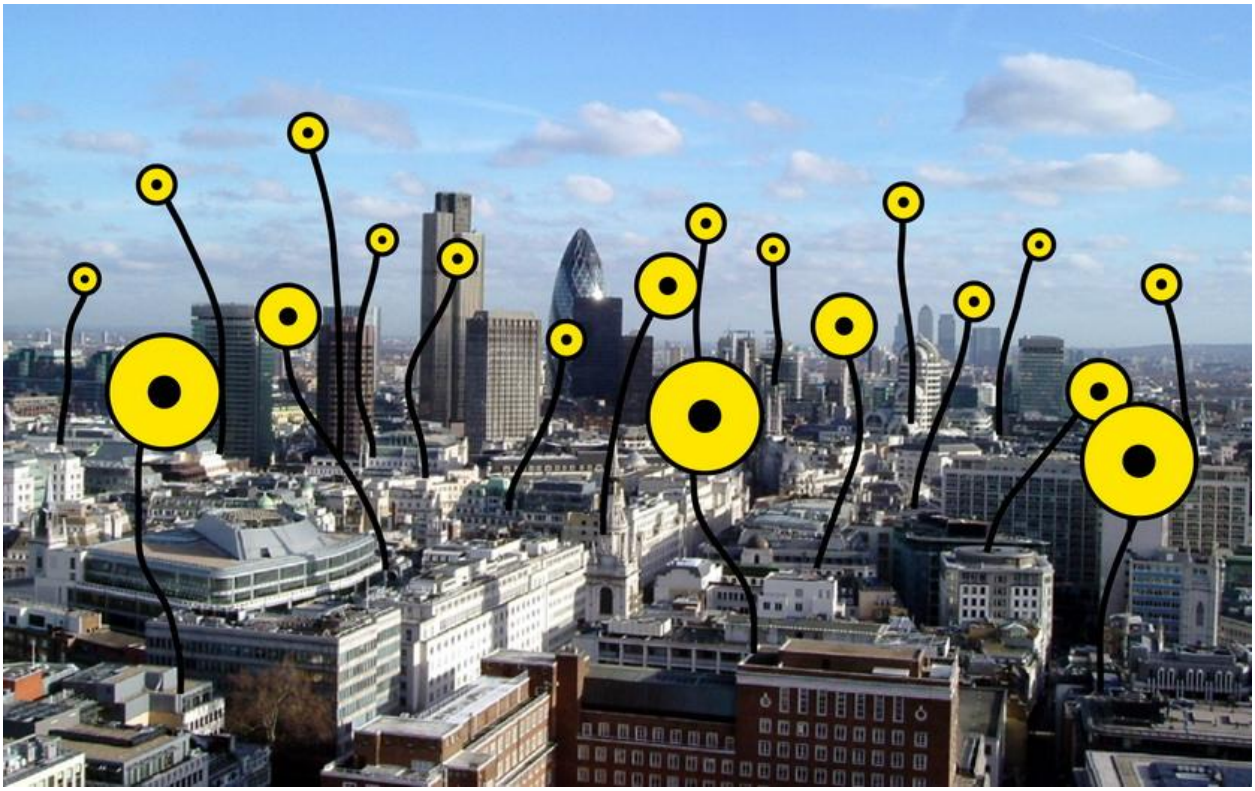

Figure 3.5 - Location-based networks in urban space

The consequences of this infrastructural literacy for the agricultural domain are, of course, enormous. With headlines popping up everyday concerning hormone-pumped poultry, salmonella in canned food, and Monsanto's genetically modified seeds, there is a growing movement amongst consumers to buy locally grown and organic produce and to develop consciousness about where your food is coming from. While new regulations from the FDA are increasingly requiring restaurants and grocers

[33] Offenhuber, p. 93.
[34] Offenhuber, p. 92

to disclose this information to consumers, low-cost sensors in distributed objects can perform the same function, allowing consumers to track the history of your vegetable from field to table. Imagine a world in which a consumer can not only check a label to see whether their tomato was “organic” or “locally grown,” but can also use an app + sensor-based systems to gain more fine-grained metadata about a vegetable’s provenance, including how far it had to travel to end up in a consumer’s hand. These technologies are increasingly being prototyped in research labs, but they have yet to reach a wide commercial context. As this infrastructural literacy - the question of where did my food come from? - is crucial to the development of any concerned consumer, the deployment of these technologies in a wider context should also be a vital part of any complete agricultural education.

Annotation Apps for Identification + Recommendation

[Insert]

Ubicomp + Learning Style

Although these case studies can be clumped together under the “big tent” of ubicomp, it is incredibly important to remember that each subsection described in this chapter presupposes a wholly distinct model of learning, each with its own social and cultural implications. In many sensor-based projects using gamification techniques like Tweet-a-Watt, a training model of education is employed, seeking to discipline the user through behavioral psychology techniques of repetition, stimulus, and response. In data-viz/sensor mash-ups like MIT’s Trash Track project, however, the goal is not to foster the self-monitoring of individual behavior, but to try and encourage critical consciousness of large scale, infrastructural problems. Finally, in many of the socially oriented annotation apps to support agricultural education, knowledge is seen as a socially negotiated process, with intelligence garnered from the deliberation and participation of a crowd. Though there exist many more pertinent ubicomp genres even within the specialized field of interaction design for urban gardening (i.e. locative games that mix physical and digital elements, augmented reality apps, etc.), we believe these three broad categories at least provide a sampling of existing approaches and demonstrate how even the same technologies can be employed towards strikingly different aims.

Now that we have identified different trends in the ubicomp space and connected them to different conceptions of learning, the aim of user-centered design is to find the appropriate connection between this implied learning style, a technology, and different social conceptions of urban gardening. For instance, for a busy urban

professional who is taking care of a plant merely as a hobby, a sensor-based system of gamification and training might be a perfect solution, as their conception of gardening is mostly solitary and for personal gratification. On the other hand, for those who want to use gardening to solidify existing communities or create new ones, the socially oriented apps described in the third section might be most appropriate. Each of these genres thus relates not only to an implied educational model but also to a distinct user group. As we embark on our ethnographic research with urban farmers in Italy, the hope is that we will be able to refine our understanding of these user groups and their associated learning styles. By starting with the educational needs and wants of the user, again, the aim is to create new technologies that are *infrastructural* - integrating seamlessly into the routines and minutiae of everyday life.

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4. Ethnography for Design: Urban Gardening in Rome, Florence, and Milan

"Design translates values into tangible experiences."
- Dori Tunstall[35]

Ethnography, from the Greek meaning "description of people," is a research methodology used in various branches of the social sciences to explain diverse cultural phenomena. Originating in the nineteenth century when anthropologists sailed to the colonies to study indigenous groups in Southeast Asia, Africa, Australia, and Central America, the methodology has since evolved through many periods of upheaval and self critique, fracturing and hybridizing into many diverse subdisciplines. One of the canonical figures of modern social anthropology, Polish-born Bronislaw Malinowski, initiated a sea change in the field by emphasizing that ethnographers "should see things from the point of view of their subjects, rather than imposing their own cultural and political prejudices on them."[36] In order to facilitate such a point of view, he advocated for the importance of a technique he called *participant observation*, in which anthropologists make daily contact with their informants in order to better record and understand "the imponderabilia of everyday life." Studying and living with the Trobriand people on a small chain of islands in Papua New Guinea for months on end, Malinowski's book, *Argonauts of the Western Pacific* (1922), represented one of the first attempts to systematize ethnography into a series of professional techniques. Reacting against what he called the "grab-bag of methods" previously employed,[37] participant observation and other ethnographic methods used by Malinowski provided researchers with a toolkit for helping to understand a foreign culture.

Attempting to overcome the field's colonialist past, western ethnographers since Malinowski have turned ethnography back on themselves to study urban, industrialized, and high tech societies. In the sphere of ubiquitous computing research, Genevieve Bell, the Director of Intel Corporation's Interaction and Experience Research Lab, has written many articles and books on the cultural specificities of ubiquitous computing use in Korea, China, Australia, and the United States. Mimi Ito, Misa

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[35] Tunstall, Dori. "Dori Tunstall" (interview). In *Brand Thinking and Other Noble Pursuits*. Ed. Debbie Millman. New York: Allworth Press, 2013. Print.
[36] van Dijk, Geke. "Design Ethnography: Taking Inspiration From Everyday Life." In *This is Service Design Thinking: Basics, Tools, and Cases*. Ed. Marc Stickdorn and Jakob Schneider. Hoboken, NJ: Wiley, 2012. Print.
[37] "Argonauts of the Western Pacific." *Wikipedia: The Free Encyclopedia.* Wikimedia Foundation, Inc., 30 Aug. 2013. Web. 20 Sep. 2013.

Matsuda, and Daisuke Okabe, in their painstakingly detailed collection, *Personal, Portable, and Pedestrian* (2005), have used ethnographic methods to study mobile phone (*keitai*) usage by teenagers in Japan.[38] Part of an increasing trend in ethnography toward hybridizing academic and corporate approaches, these books provide insights into the cultural systems and practices of industrialized societies of which the ethnographers are already a part.

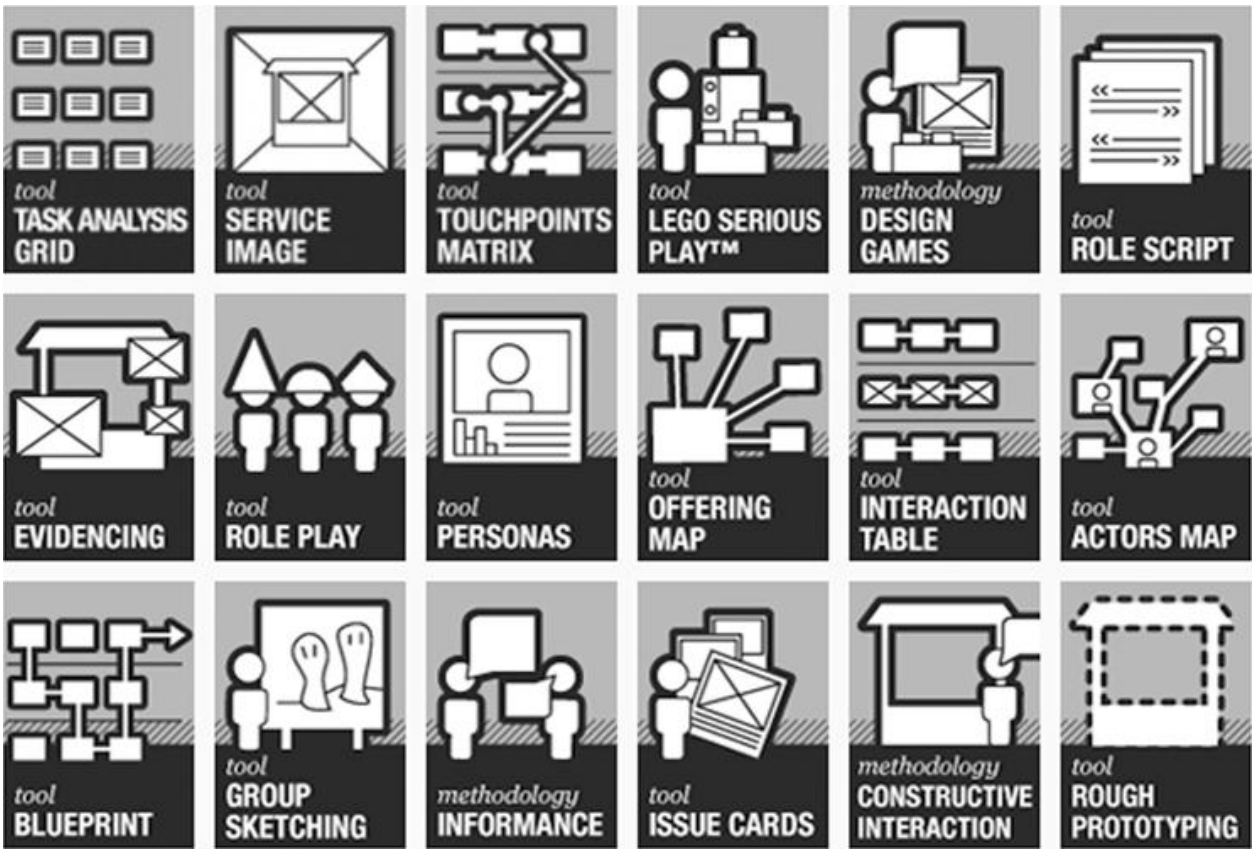

Figure 4.1 - Chart of User-Centered Design Methods

Design ethnography, which can be seen as a subsection of the movement described above, is a methodology which seeks to place ethnography at the center of a human-centered design process. As Geke van Dijk puts it in his contribution to the book, *This is Service Design Thinking*, design ethnography uses the traditional tools of ethnography to "build up an empathic understanding of a user's practices and routines

[38] Ito, Mimi, Misa Matsuda, and Daisuke Okabe. *Personal, Portable, Pedestrian: Mobile Phones in Japanese Life*, Cambridge: MIT Press, 2005. Print.

and what they care about."[39] Designers then use this deep understanding of human behavior culled from ethnography in order to "work on idea generation, concept development, and implementation" that will then be targeted to those same groups.[40] In contrast to more quantitatively oriented "user research" in marketing and advertising, which might ask potential users to answer predetermined questions through surveys and focus groups, the human-centered, qualitative focus of design ethnography involves more fluid "interaction, conversation, and co-creation" in order to better understand a user's wants and needs.[41]

If the penultimate aim of ubiquitous computing is indeed to invisibly integrate itself into the routines of everyday life, it should come as no surprise that, since the field's beginnings over twenty years ago, design ethnography has played a central role. According to their own accounts, Mark Weiser and other ubicomp pioneers at Xerox PARC were heavily influenced by social scientists like Lucy Suchman and her Work Practice and Technology Group at Cornell. [42] Other ubicomp research groups at a wide variety of private and public institutions like Georgia Tech, MIT, Microsoft Research, the University of California, Lancaster University, and Nokia have also displayed their commitment to ethnographic approaches by incorporating social scientists on their design teams. As Dourish and Bell note, within these contexts, the main aim of the ethnographer on a ubicomp research team is to generate "implications for design." By deploying a keen, trained eye to the fuzzy domains of human rituals, kinship, play and work, design ethnography seeks to "provide a bridge between the service users, the service providers, and the service designers."[43]

Of course, the actual process behind the utilitarian phrase "implications for design" is not as tidy as it may initially seem. Deep knowledge of a place does not simply exist objectively "out there" to be discovered by the adventurous ethnographer, but is always mediated through the subjectivity of the observer. Thus, as we embarked on our trip to Italy to conduct ethnographic research with urban gardeners in Rome, Florence, and Milan, we knew that in many ways we were creating both an account of contemporary Italian urban farming and an American perspective on that story. Balancing those approaches, and in particular trying to document cultural specificities from an outside perspective, was in many ways a messy and imperfect process. However, as ubicomp is continually produced as a dialogue between users,

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[39] van Dijk, pg. 108.
[40] van Dijk, p.108.
[41] Ibid., p.109.
[42] Dourish and Bell, p.63.
[43] van Dijk, p. 114.

technologies, and their larger cultural contexts, design ethnography represented a way for our team to (tenuously and imperfectly) connect theory to practice.

The Garden on the Hill: The American Academy in Rome

Figure 4.2 - The American Academy in Rome Courtyard

The American Academy in Rome sits atop Gianicolo (Janiculum Hill) on the western edge of Italy's capital, ascending from the winding nooks and crannies of the Trastevere district below. An august and stately institution which once served as Giuseppe Garibaldi's headquarters, the villa acts as the home to scholars, artists, and architects lucky enough to have won the Rome Prize, a prestigious honor which allows them to stay in Rome for an entire year and soak up inspiration from Italian culture. Filled with lush gardens, perfectly manicured grounds, and rare artifacts from antiquity, the academy's villa represents the ideal space for immersing oneself in the source of Western humanistic heritage. Physically separated from Rome while at the same time intangibly connected to it, the American Academy is a purposefully anachronistic hideaway - a space where artists and scholars can take a respite from modern life and

reflect, create, and bask in the tranquility all around them.

For many years, this idyllic setting belied the academy's most terrible secret - a notorious reputation for terrible food. Despite being located in one of the great food capitals of the world, Rome Prize winners and fellows often compared meals at the academy to the stereotypical cafeteria food at other educational institutions - filled with wilted vegetables, boxed pasta, powdered mixes, and "casseroles with no identifiable ingredients."[44] The quality of the food at the academy became such a problem that administrators noticed many of the fellows, who were supposed to use the dinner table as a space to cross-pollinate ideas, had stopped coming to meals.[45] "If people aren't coming because the food is terrible, then the kind of exchange we want to encourage just doesn't happen," said Carmela Vircillo Franklin, the academy's director.[46]

Figure 4.3 - Garden-fresh meals at the American Academy in Rome

[44] Rosenthal, Elisabeth. "In Rome, The Academy Learns to Cook." *New York Times*. 13 Mar. 2009. Web.
[45] Ibid.
[46] Ibid.

In order to tackle the problem, the academy brought in Alice Waters, the famed chef and co-founder of Chez Pannise based in Berkeley, CA. Known for her commitment to sustainable, organic, seasonal and local principles, Waters brought the academy away from its use of industrialized food by encouraging them to start their own kitchen garden. Replacing most of their flower beds with gardens that would produce salad greens, radishes, herbs, and peppers,[47] the American Academy garden now contributes a large percentage of the vegetables used to feed the 50-70 fellows and their families. What is not grown directly on the grounds is culled from local farmers or foraged from local orchards and forests. The gardens only use seeds produced from their own seed stock, vegetables are only grown in season, and all food scraps are composted. Since the new program's implementation, the fellows have enjoyed the new food culture so much that they can often be found tilling soil or shelling walnuts right alongside chefs and kitchen hands.

Given this amazing turnaround story, we felt that the American Academy would be a perfect site to engage in ethnographic research for our project. Because they were so successful in using a garden to revitalize and foster community, we wanted to learn more about the mechanics of their food program revitalization - and more specifically, the ways that their patrons learned to grow their own food from one another. We wanted to know how it was that the Rome Fellows, scholars and artists with little to no prior knowledge of urban gardening, came to be involved in the farming process; what specific agricultural techniques, media forms, and technologies were used to support their learning; and how it was that the academy encouraged this kind of knowledge to live on when the Rome Fellows returned back home. We sat down with Chris Boswell, Waters' sous chef at Chez Pannise and now executive director of the American Academy's food program, to begin to answer these questions.

[47] Rosenthal.

Figure 4.4 - Chris Boswell, Executive Director - Rome Sustainable Food Project

Being a gracious host, Boswell began our visit with a tour of the grounds. He showed us the olive trees where the academy pressed its own oil, the hedges where they got their bay leaves, as well as the thyme and rosemary creeping along the villa's walls. When we got to the site of the vegetable gardens, he began telling us about some of the specific urban gardening techniques used by his staff, as well as some kindred projects worldwide which inspired the American Academy. He spoke about the innovations of urban gardeners in England who built elaborate, walled enclosures for their gardens to protect their vegetables from the harsh northern climate and maximize productivity throughout the year. He also spoke about Eli Zaber, owner of the renowned Vinegar Factory grocery store in New York City, who in trying to deal with the shrinking availability of urban real estate, innovated the idea of Brooklyn's rooftop greenhouses. In contrast to most urban gardening, which is mostly limited in scale to "a windowbox harvest of a few herbs,"[48] Chris marveled that these innovations did not attempt to make any compromises, creating fully-fledged gardens to feed multiple people, even within conditions of industrial squalor and limited space. If it was possible in England and New York City, Chris argued, it had to be possible in Rome.

[48] "Eli Zabar's Rooftop Garden." *Martha Stewart Living Television*. Martha Stewart Living Omnimedia. Web. 2 Sep. 2013.

As we made our way along the winding paths of the grounds, Chris began discussing some of the specific techniques his team used to ensure a Slow Food friendly garden. Although he glossed over an amazing out of material (from composting techniques to reusing seeds from last year's harvest), the most surprising and interesting information to me was a technique called companion planting. Innovated by Native Americans before the arrival of European settlers, companion planting is a system for planting different crops in proximity to one another for pest control, pollination, nutritional benefits, and plant growth.[49] For instance, in the Academy's own garden, Chris noted the ways that companion planting allowed his *alliums* such as onions, garlic, leeks, shallots, and chives to grow especially well when placed next to tomatoes and broccoli. Although widely used by farmers and gardeners committed to sustainable and organic principles, when I asked Chris what was the best way to find information about companion planting, he said that simple charts online were the best available option. The lack of other technological resources for companion planting struck me as a bit odd given its prominence as an important technique in the community, but I simply made a quick note of it and moved on.

After the tour outside, we gathered with the Rome Fellows at the academy's bar for a quick cappuccino, as Chris went on describing the academy's internship program. The internship program, which was initiated with the revamped food program, allows anyone from food bloggers and aspiring cooks to food policy activists and rural farmers to be immersed in the culture of the academy and prepare food for the community. The interns are introduced to the entire food production process from field to table, working in the academy's kitchen and garden for five months, for a full five days a week. While there is a required, one week training period at the beginning of the internship, Chris assured us that the majority of the learning occurred through a non-hierarchical, apprenticeship model, in which the interns learn from more experienced chefs but also contribute their own specialized knowledge sets to the preparation of delicious and nutrition food. Although not officially required to be involved, Chris noted that the Rome Fellows themselves often took pride in working alongside the interns in the kitchen and the garden preparing the food. The garden, the kitchen, and the table of the academy thus all became a kind of sacred social space in which peer-to-peer and cross-generational knowledge exchange could occur.

As our tour came to a close and we arrived back at the academy's front gate, I asked Chris about the potential he saw for the American Academy's model to be

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[49] "Companion Planting." *Wikipedia: The Free Encyclopedia.* Wikimedia Foundation, Inc., 13 Sep. 2013. Web. 15 Sep. 2013.

replicated around the world. He sat in thought for a second, then replied with a carefully crafted sense of tempered optimism, which, I remember thinking, seemed absolutely appropriate for an environmental activist. On the one hand, he began, he believed that what the academy was able to achieve in Rome could be replicable on smaller scales. Like they have done for many years, urban dwellers of all ages could start small - creating tiny plots on their roofs and balconies and grow a few vegetables, though probably not enough to feed more than a single person. As people grow more aware of the harm stemming from Monsanto and genetically modified seeds, he went on, the increasing popularity of urban gardening made him more optimistic by the day. If everyday busy people were making a concerted effort to return to the earth, perhaps there would be a way to at least partially break from the toxic industrialized food system and reclaim some knowledge of where their food is actually coming from.

But in a deep insight of almost auto-ethnography, Chris then added an important caveat - urban gardening is a wholly different ball-game depending on the cultural context in which you practice. Italian urban farmers, he argued, with their long-standing tradition of sustainable agriculture and laurels as the birthplace of the Slow Food movement, are trying to use urban gardening as a way to *maintain* a food tradition in the face of increasing efforts to assimilate more fully into the global food market. US urban farmers, on the other hand, who live in a country which has been fully embroiled in the industrialized food cycle for many, many years, are now trying to use the Slow Food movement to *reclaim or reinvent* a new relationship to the earth through sustainable and organic practices. The distinctions between these relationships are subtle, Chris conceded, but they also make a world of difference. They help to explain the greater visibility and popular support for urban gardening in Italy in contrast to the United States, and at least partially explain why there was such a push to ban GMOs in the European Union. They also help to explain why Slow Food in Italy is much more intergenerational and all encompassing than in the U.S., where it skews mostly into a younger, urban, and progressive demographic. As Chris and a few of the Rome Fellows shut the gate door behind us and we all gave our thanks and warm goodbyes, our team was left pondering these cultural specificities and how to accommodate them with technology. We descended down the famed Gianicolo hill both pensive and inspired, returning with much to think about back in urban reality.

Hack, Reuse, Recycle: Guerilla Gardeners in Florence

Figure 4.5 - The Garden of Eden in New York City

In the mid-1970s, an eccentric man who called himself Adam Purple planted a few lilies in an abandoned lot in the Lower East Side of Manhattan. Inserting a brilliant spot of color into the typical browns and greys of New York's urban squalor, no one seemed to mind his quiet presence as he diligently tended to his small plot daily. And yet what started as just a few flowers soon grew over the years into a 15,000 square foot "Garden of Eden," complete with raspberries, roses, fruit trees, and other fresh produce beautifully arranged in elaborate configurations.[50] As his garden grew and he engaged in more confrontations with city officials over ownership of the space, he soon became enshrined in NYC folklore, like a modern day Johnny Appleseed. Now

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50 Copage, Eric V. "Neighborhood Report: Lower East Side - Update; Mr. Natural Goes Electric." *New York Times* 15 Aug. 1999. Web.

considered the “grandfather” of the urban gardening movement, Purple has inspired Guerilla Gardening movements worldwide from the People’s Park at UC Berkeley to the famed South Central Farmers in Los Angeles.[51] A classic holdover from the hippies and progressives of the 1960s, Purple saw his gardening in explicitly political terms - as an act of defiance in reclaiming public space back for the local community.

Having just read about Purple and other guerilla gardening activists on the *frecciarossa* (fast train) from Rome to Florence, our team approached the headquarters for the Florence chapter of the Guerilla Gardeners not really knowing what to expect. Would we be meeting with anti-establishment, co-op, or activist types, trying to build a utopian food ecosystem entirely outside the mainstream? Or perhaps we would be spending our company with back-to-nature luddites, who would view our attempts to merge ubiquitous computing and gardening with disgust or at the very least suspicion? Having only read about Guerilla Gardening case studies in the United States, we were also curious about how the movement had morphed to accommodate the local Italian context. All these concerns weighed upon our shoulders as we made our way up the headquarters’ cobblestone steps.

[51] “Adam Purple.” *Wikipedia: The Free Encyclopedia.* Wikimedia Foundation, Inc., 21 Jul. 2013. Web. 10 Aug. 2013.

Figure 4.6 - Giacomo Salizzoni, Director - Guerilla Gardeners, Florence

We were buzzed into the building by Giacomo Salizzoni, the head of the Guerilla Gardeners' Florence chapter. As we entered the main atrium of the GG's workspace, I realized that the space was not what I expected at all. With minimalist furniture, sleek Macintosh computers, and heavy coffee table books inhabiting a white cube space, the trappings reminded me more of our home at the MIT Media Lab than those of a grungy urban gardening activist. When Giacomo mentioned that he had a past life as an architect, it suddenly all made sense. We were in the studio space of a kindred spirit - someone who was trying to use design with a civic and sustainable orientation.

Giacomo began his meeting by pointing out some of the obvious differences between his chapter and the rest of the Guerilla Gardeners worldwide. While many of the other actors in the movement still saw themselves as anti-institutional and oppositional in the spirit of the Situationist International,[52] the Florence chapter was much more interested in how to work in the system to improve it from within. To illustrate, Giacomo brought up the example of a publicly subsidized, garden allocation system in the city of Florence, which gives 500 sixty-square meter plots to elderly people living within the city bounds. According to Giacomo, these gardens are often used to produce fresh fruits and vegetables, but the simple act of caring for the garden also serves a therapeutic function for elderly men and women who may be in poor health. While Giacomo seemed incredibly inspired by this innovative program, he also thought that many aspects of it can be improved by integrating more of a community emphasis. Rather than having a dispersed network of small, individual plots, Giacomo believed that a series of slightly larger community gardens placed at strategic spots within the city would provide citizens with more of an incentive to participate. Community gardening events could be paired with outdoor classes about cooking and nutrition, composting, and sustainable practices. Calming activities like tai-chi, yoga, and pilates could fulfill the therapeutic needs of senior citizens. And any produce generated from the garden could go either to the local food bank or to the official owners of that space - for instance, the pilot garden that Giacomo started now donates their produce to the plot's official owners, The Four Seasons Hotel. Like any good interaction designer committed to user-centered design, Giacomo started with the existing needs and practices of his network of stakeholders, using these as inspirations to strengthen bonds within the target community.

In order to foster this intergenerational knowledge exchange, while at the same

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[52] For more information on Guy Debord and the playful, yet political urban interventions of the Situationist International, see Debord, Guy. *The Society of the Spectacle.* Kalamazoo, MI: Black & Red, 2000. Print.

time keeping the various private and public stakeholders at bay, Giacomo crafted a stunningly diverse transmedia educational strategy, aimed at targeting multiple user across a number of demographics. Utilizing everything from interactive comics and iPad applications to community blogs which allowed senior citizens to document their gardening experiences, Giacomo bristled with excitement over the potential of these technologies to support gardening education. Considering both experiential and pragmatic dimensions, and working in an explicitly cross-generational frame, it immediately became clear that Giacomo and our team were speaking the same language and tackling many of the same issues. The more we listened to him speak about his projects, the more we knew that the information he provided would be invaluable as we began prototyping our own project.

Figure 4.7 - Giacomo Salizzoni, Seed Cards

As he excitedly took toy after toy off his shelf, I realized that his experiments that I was most drawn to were those that involved some aspect of recycling or biodegradability. One project involved a self-watering, hydroponic system that used recycled tea bags filled with fertilizer to help provide nutrients to a pot. Another project

targeted at children used the metaphor of collectables to encourage them to gather as many different types of seeds as possible. Akin to hobbies like collecting Pokemon cards, coins, or stamps, the project gave users a set of cards with perforated indentations, which could then be filled with different varieties of seeds and eventually planted, as the cards were made of biodegradable paper. Our team felt that this latter concept was particularly strong, as it both incentivized the creation of a diverse garden, while simultaneously using collection materials in the garden's actual planting phase. The conceptual work of collecting thus directly interfaced with the materiality of planting an actual garden, merging the physical and the abstract in extremely interesting ways.

Towards the end of the show-and-tell session, Giacomo pulled out an old, laminated chart which he said was used to support companion planting. Of course, given companion planting's conspicuous presence in our discussions with Chris at the American Academy in Rome, our team immediately perked up our ears, as we knew that we had potentially struck research gold. Filled with long lists of vegetables on both vertical and horizontal axes, the chart displayed a green dot where a beneficial relationship existed between the two matched plants, and a red dot when the two inhibited each other's growth. Giacomo went on to state that while there were some basic scientific rules governing companion planting relationships, the information in this particular chart was entirely collected based on oral interviews with local Guerilla Gardeners in the area. Hearing this information set my mind reeling with possibilities for a digital adaptation, as I realized that the chart was basically crowdsourced and companion planting was basically a combinatorial and algorithmic process. My first thought was that the chart could be incredibly well-served by some sort of AI recommendation system; my second thought was that it could work as a knowledge sharing-cum-social networking platform like Quora. As the ideas came pouring in, I furiously scribbled them down in the ideation section of my notebook to consult later with the team.

Figure 4.8 - Giacomo Salizzoni, Companion Planting Chart

One of the last items that Giacomo showed us was a seed bomb that he specially designed from clay, compost, and used tea bags. When I held the tiny item in the palm of my hand, I carefully eyed the object and smiled, as I felt that it totally encapsulated everything that Giacomo and the larger Guerilla Gardeners movement was about. On the one hand, the packet was delicate and aesthetically pleasing, clearly designed by an individual with taste and an eye for form. On the other hand, it represented the tougher, oppositional side of the Guerilla Gardeners - these "bombs" (sometimes called "green grenades") were used as a means to "challenge access to urban space and improve the condition of land sooner than bureaucracy."[53] Listening

[53] Dionisi, Brenda. "Greener Pastures: Ideas for an Urban Green Revolution in Florence." The Florentine No.139. 24 Mar. 2011. Web.

to Giacomo talk about the history of seed bombs, I began to imagine the Guerilla Gardeners almost like graffiti artists, working in the medium of foliage rather than spray cans, or like MIT's hackers, who had performed such illustrious feats as placing a cow on top of the great dome of Killian Court and turning the earth and environmental science building into a giant Tetris board. Reversing an official narrative of a space, and reclaiming it for the oppositional and the tactical, with humor, beauty, and aplomb, the guerilla gardeners, the graffiti artists, and the hackers all seemed to develop a family resemblance for me in the image of the seed bomb.

Figure 4.9 - Giacomo Salizzoni, Seed Bomb

Having shown us practically every item on his shelf and having saddled us with bags full of parting gifts, Giacomo walked us out to the front door of the Guerilla Gardeners headquarters. The minute the door closed behind us, our team immediately began blurting out potential concepts inspired by the visit; our method basically consisting of throwing everything against the wall and watching what sticks. We argued vehemently (and loudly) all along the Ponte Vecchio, only to be pacified by the passing sight of a gelato shop. We then sat by the river, working diligently at our ice cream cones in relative silence, the creativity and excitement from the visit still buzzing in our heads.

Nature and Sensation: The Parco Segentini Association in Milan

Figure 4.10 - Terrace community garden in Milan

Having spent our last two site visits meandering the ancient cobblestone streets of Rome and Florence, our arrival at Milan's Stazione Centrale provided something of a shock. Although Milan had its own historic sites like Castello Sforzeco and the breathtaking Duomo (Domed Cathedral) at its city center, much more important to the city's ambience were new temples to design, fashion, technology, and finance. As Italy's main industrial, commercial, and cultural center, Milan felt like many other world-class, global cities – filled with skyscrapers, modern architecture, and designer shopping, it seemed almost like the Italian counterpart to New York City, London, Tokyo, or Hong Kong. As our team stepped in and out of subways and navigated through bustling crowds of working professionals, bankers, tourists, shopkeepers, and street performers, there was a sense that we were immersed in a bustling urban flow, an ever accelerating complex system that must have looked like ants from outer space.

Although this sense of speed is certainly key to the excitement generated by the city, for many Milanese, such a busy lifestyle necessitates therapeutic green space. In the northwest region of the city, Milan's largest green space, Sempione Park, contains a beautiful Japanese garden, leisurely walkways, a public library, and the city's aquarium. Slightly away from the city centre, Forlanini Park hosts a large pond and

historic farm houses leftover from the area's agricultural past.[54] The Montanelli Gardens, created in the 18th century, are a veritable urban oasis, featuring small waterfalls, lakes and bridges, lime trees, a soccer field, and geometric flower gardens. Thus, despite the fact that Milan is located in one of the most urbanized regions in all of Italy,[55] green space continues to assert its presence across the concrete landscape, speckling pockets of nature into even the most urbanized of areas.

The problem with many of these parks, however, is that the municipal government makes most of the decisions about how the space will be used. Part of a series of urban renewal initiatives commissioned in recent years, Milan's parks have undergone a number of beautification efforts, even featuring public art pieces commissioned by the local Museum of Contemporary Art. And yet, while the overall response to these initiatives has been mostly positive, everyday citizens have been largely absent from many of these planning decisions. Unlike a large number of participatory planning movements which have taken off in cities all over the world, the approach in Milan in recent years has largely consisted of top-down, bureaucratic decisions.

Riccardo Casalegno, a retired civil engineer and advocate for citizen participation in planning, imparted some of this history to us as we sat nestled amongst his tomato plants, looking out from the amazing birds' eye view of the city atop his rooftop garden. As the co-founder of a group called the Parco Segantini Association, Riccardo worked with citizens of all ages from his neighborhood in Milan in order to advocate for farmable green space within the area. As a kind of go-big-or-go-home kind of fellow, Riccardo's current project approached the scale of a pipe dream: to reform the Sieroterapico Milanese in the Navigli area into the third largest park in Milan. Although many have chided him over the years at the thought of such an ambitiously scaled project, Riccardo has already begun talks with the city in trying turn his dream into a reality.

However, true to the spirit of Milan, this was no ordinary park, but an experimental green space in which art, technology, and design played an integral role. Garnering the participation and input of many citizens of the neighborhood as well as local businesses, the park will be clustered around an interconnected chain of modular enclaves, with each devoted to one of the five senses. For instance, working in collaboration with the local design university, the "sight" area of the park will have a

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[54] "Milan." *Wikipedia: The Free Encyclopedia.* Wikimedia Foundation, Inc., 6 Oct. 2013. Web. 10 Aug. 2013.
[55] Ibid.

series of ingenious infrared cameras which citizens can use to measure local plant health. The “taste” area of the park will have a kitchen garden producing vegetables for the local community. Perhaps most interestingly, the “touch” area of the park will have a small “fab lab,” or workshop space for digital fabrication of personal physical artifacts. Featuring technologies for laser cutting, 3-D printing, rapid prototyping, and DIY electronics, the idea is to empower citizens with the tools to create new objects for themselves, especially in contexts where industrialized products do not serve the needs and specificities of the local context.

Figure 4.11 - MIT Team with Riccardo Casalegno

Although Riccardo’s overall plan for the park seemed to be less explicitly interested in urban gardening than, for instance, Chris Boswell’s activist commitments at the American Academy in Rome, I could already see in our conversations that there was much we could learn from his approach. As we sat on that rooftop looking simultaneously at his blueprints for the park and the layout of the city below, it was clear that Riccardo had a big picture, infrastructural understanding of the park and its role in the city, wholly appropriate for a civil engineer. And yet, at the same time, he seemed to appreciate art and community, as the entire concept for the park was rooted at the level of the human sensorium. Thus, even though we were sitting atop a building looking at the city grid in the manner of an urban planner, the emphasis was somehow still bottom-up and wholly human.

While our ethnographic research with Riccardo consisted merely of a single conversation, it provided us with striking insights into the relationship between grassroots communities and municipal governments. Although there was some discussion of this topic when Giacomo discussed the garden allocation system for the elderly in Florence, talking with someone like Riccardo who was currently in the process of working to build something as large scale as a park was incredibly valuable, and alerted us to issues of the control of space in cities where it is especially scarce. While our team will certainly not be building a prototype which remotely verges on the scale of a park, keeping these issues of control of space in mind will be incredibly important, as it relates to the problem of the size of a plot that a person can garden on, as well who owns the vegetables that are produced in that space. As we scribbled down our last notes from this ethnographic visit and hopped on a plane back to Cambridge and MIT, our team was left pondering how to reconcile these dreams of utopian, art and- technology-filled green spaces and the realities of urban planning and stultifying bureaucracy.

"Implications for Design"

As Genevieve Bell and Paul Dourish note in *Divining a Digital Future*, perhaps the most important section of any HCI or design ethnographic report is the list of "implications for design." Wading through the surfeit of extraneous details, interview transcriptions, and notes scribbled on post-its, the implications for design section (at its best) extracts those details which are most salient, organizes them into a coherent thematic framework, and synthesizes them into a series of digestible points. Coming back from Rome, Florence, and Milan, it was clear that we had amassed a wealth of fascinating material. But how could we connect our ethnographic research to the trend research we had completed before our site visits? And how could we synthesize the cumulative insights gained from mashing up all this research into insights that could actually inform the design of a physical prototype?

We began this synthetic process by creating a structured template culled from patterns and repetitions we saw emerging across the three ethnographic sites. After much negotiation, we identified five key categories of takeaways that could inform our ideation process: (1) institutional contexts or motivations for gardening; (2) educational methods; (3) farming techniques; (4) dream technologies; and (5) contextual takeaways. While some of these takeaway categories (such as 1 and 5) were clearly more big-picture in scope, it also became increasingly clear that these more abstract insights were just as important to remember as the small, specific details in crafting an

appropriate user experience for the target demographic. For instance, learning about the different relationship to the Slow Food movement in the United States versus Italy (from our visit to the American Academy in Rome), provided deep insights into urban gardening in the Italian context. Likewise, learning about Florence's public, garden allocation system (from Giacomo at the Guerilla Gardeners headquarters), alerted us to the institutional contexts which might help or hinder community gardening projects. While this set of insights may not be as concrete as a list of educational methods or farming techniques, it is also clear that ignoring any of these big-picture takeaways could be disastrous in creating a user experience which is not attentive to local context.

Of course, our list of educational methods and farming techniques was also vital. Although the list is potentially extensible, these were the most salient trends we identified from our site visits:

Catalogue of Methods

FARMING METHODS	EDUCATIONAL METHODS
Seasonal	Tutorials and lectures by an expert
Local/regional/Km 0	Management of time, repetitive tasks =→ teaching responsibility
Companion planting	Combinatorial learning, playing with parameters.
Varying spatial configurations of plots	
Hydroponic pot systems	Hands-on-learning, learning-by-doing (constructivism)
Automated watering systems	Sensory learning
Care of an individual plant.	Word-of-mouth, peer-to-peer learning
	Intergenerational exchange

Figure 4.12 - Catalogue of educational + farming methods culled from ethnographic study

Although we didn't necessarily forecast the importance of this so-called catalogue, seeing these methods in two, easily digestible lists immediately (and unexpectedly) set off the brainstorming process for our team. As we began to see in our trend research on pragmatic approaches in ubiquitous computing, each genre of

ubicomp came attached to a series of educational methods - for instance, sensor-based projects with a gamification element often focused on training the user through time management techniques, incentives, and repetitive tasks. But as our team sat looking at the two lists, we began deliberating: what if we could expand this approach for trend research into a methodology for brainstorming concepts? How could we begin mixing various educational methods with useful farming techniques, and then find the appropriate technologies to help support that conceptual pairing?

Like the famous experimental poetry collective, Oulipo, we then began cutting each element of the list onto its own individual slip of paper. With each educational method, farming technique, and technology on its own modular unit, we then began playing a low-tech game of combinatorial creativity - a simple exercise of mix-and-match. Immediately, it was clear that the technique was generating interesting questions: for instance, what kind of concept could incorporate the farming method of hydroponic pot systems with the educational technique of constructivist, hands-on learning? Or what would a concept for care of an individual plant look like if its core educational principles were teaching responsibility or intergenerational knowledge exchange? We began playing with these cut-out slips piecing them together in novel combinations, hoping that the friction between two methods would spark a great idea. We played at this mind game for hours, pairing and unpairing the slips together like fridge magnets, arriving at a few okay ideas and a growing pile of duds. Until finally, we arrived at a concept that we all agreed was gold: SeedMate, a puzzle card game and augmented reality app for teaching the basics of companion planting.

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5. SeedMate: Play a Game, Plant a Garden

Figure 5.1 - SeedMate cards planted in a small plot.

SeedMate is a combination puzzle card game and augmented reality app to teach the basics of companion planting. Within the game, the playing field or board is a plot of soil and the playing pieces are biodegradable seeds cards. Players place the seed cards in the game on the soil according to companion planting rules, drawing on scientific principles for which plants benefit from being planted next to each other. In order to access information about plant compatibility, players use an augmented reality app on their phone and point it at codes hidden within the cards. Once all cards have been played, they can be planted on the spot, and the resulting board layout is a complete permaculture garden.

Although this short paragraph describes the core idea of our SeedMate concept, it should be clear from the user-centered design process described in the previous chapters that a vast amount of research, design, and technical work went into the production of this concept and its physical prototype. In the pages that follow, we will

describe each of the components of the SeedMate prototype in detail, how it relates to our previous trend and ethnographic research, and consequently how we feel it provides an innovative, ubicomp solution to the original problem of agricultural education.

Game + App Design

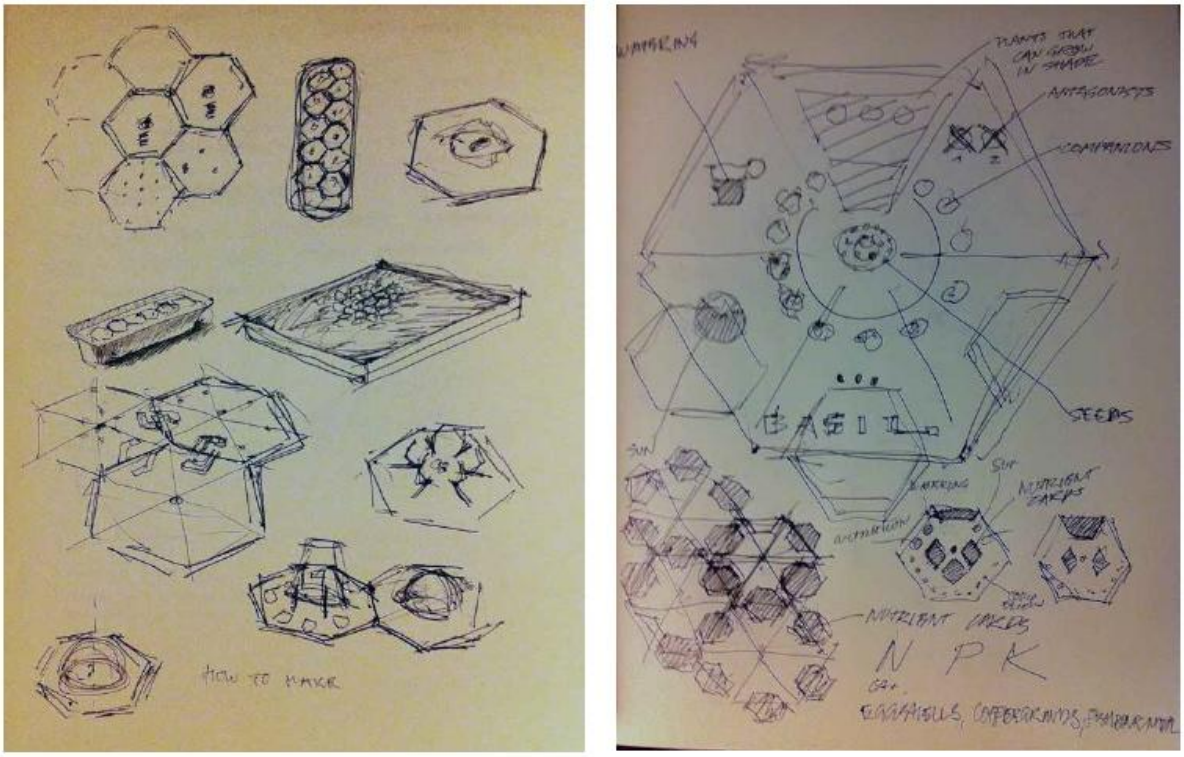

Figure 5.2 - Early prototype sketches of SeedMate plots and board layout.

As we described in both the ethnographic and trend research, urban gardening is a complex system involving the emergent interaction of multiple parameters. This system can increase exponentially in complexity as new factors are added into the mix, but one farming technique that particularly relates to this idea of systems thinking is companion planting. As a technique that came up again and again in our visits with both Chris Boswell at the American Academy in Rome and Giacomo Salizzoni at the Guerilla Gardeners headquarters in Florence, companion planting is a combinatorial process involving modular units - for instance, you can combine basil with tomatoes or onions due to their inherent physiological properties, but not with chives. This notion of laying out the spatial configuration of a garden based on these combinatorial principles seemed like a fascinating puzzle to solve in real life, so we figured that it might also be fun and informative to import this kind of knowledge into a game.

Although digital games are, of course, well known for their ability to simulate complex systems, board and card games can achieve the same effects with simpler materials. For instance, in the renowned board game, Settlers of Catan, players are forced to think about the proper allocation of resources (wood, bricks, sheep, and ore) that will allow them to build the widest settlements to overtake the real estate of the space of a board. How players allocate their resources affects the choices they can make later in the game, as well as the choices which are available to other players. Although there are only a few simple rules for placement of settlements and turn taking, extraordinary amounts of complexity and strategy are generated from within these few, productive constraints. Thus, much like an urban planning simulation games like *SimCity*, a complex spatial planning process is prototyped, but with significantly less technical overhead.

Figure 5.3 - Playtesting SeedMate rules with Philip Tan, Director of the MIT

Game Lab

The idea with SeedMate was to try and achieve a similar level of complexity using the rules of companion planting and the sunlight and shade requirements of each plant as a base. Play-testing and refining our rules with Philip Tan, Director of the MIT Game Lab, we eventually came up with the following constraints:

The start state for the game would be a public pool of seed cards, which come in a variety of sizes and shades corresponding to the physiological needs of each plant. For instance, tomato seed cards are significantly larger in size than the cards for basil or chives, because tomato plants require significantly more space to grow in real life. Similarly, the shade of the tomato card is a darker brown, connoting that it can tolerate more shade than basil, which is colored white. Again, although these representational strategies have salience within the realm of the game rules, they also have real implications for the generation of a player's actual garden. As the seed cards are played directly on soil and planted in the exact spatial configurations which were generated in the game, we aimed to create rules that were based on scientific research in companion planting and the sunlight and shade requirements of each plant.

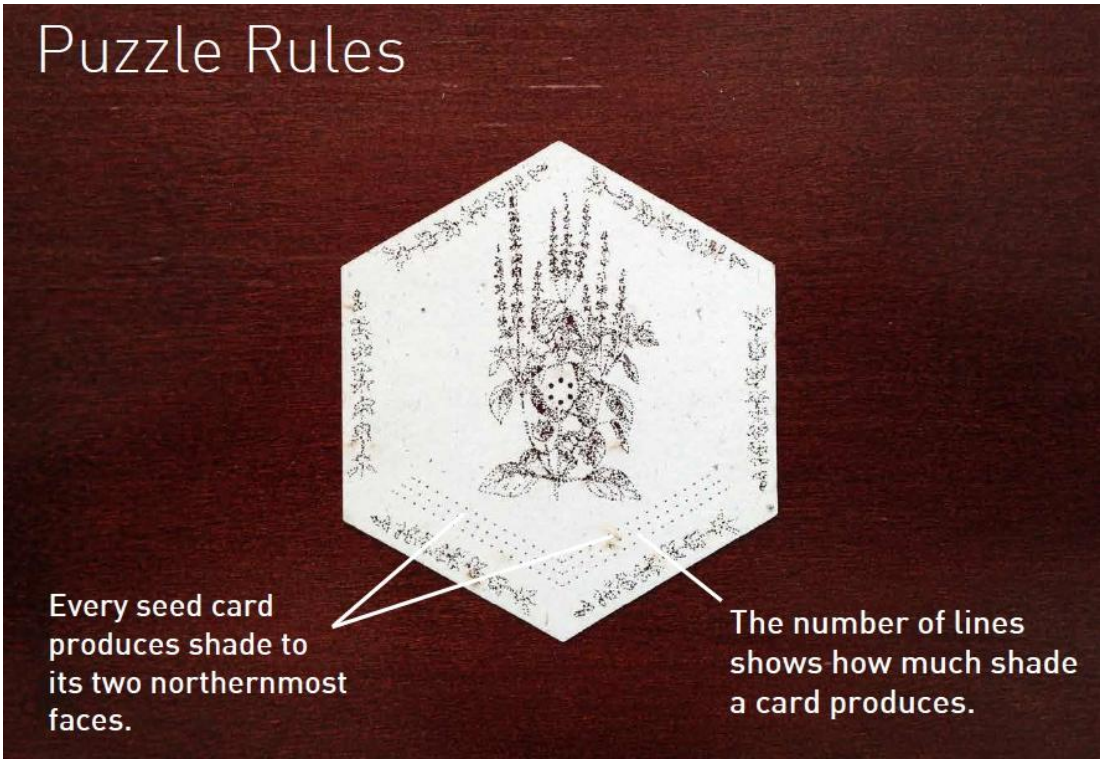

Figure 5.4 - Diagram communicating game rules embedded in SeedMate cards

Information about companion planting relationships is accessed through the augmented reality app on a user's smartphone. Simply by pointing one's phone at the intersection of two seed cards, the user can check whether two plants are compatible, and consequently, whether they can be both played next to each other in the game and eventually planted adjacent in real life. However, when the player points the AR app at the center of image of a single seed card, she can access ancillary information about nutrition benefits, cooking tips, and planting tips for that particular plant. While this information doesn't necessarily relate to the core mechanics of the game, we felt that it might be interesting to include such information, since we were specifically designing for an educational context.

Figure 5.5 - Augmented reality application used to access information from cards.

Although SeedMate can be played alone like Solitaire in a single window side pot, the game can also be played with a large number of players depending on the size of the desired field. The game can, thus, support the needs of a busy urban user who is only taking care of one plant and merely gardening as a hobby, as well as those who are interested in using gardening to foster some sort of community. In trying to accommodate this community-oriented view of gardening, the main goal of the game is to try and collaboratively create the best companion garden possible, rather than compete and "win" over another the player. Much like a Jigsaw puzzle, the nature of

the game is to enter a quiet and contemplative state and to work together to achieve a common task: building a real urban garden through play.

Although our key target user is the novice gardener who has little to prior knowledge of urban gardening, we have also considered ways that SeedMate kits can be extended and franchised to accommodate more “hardcore” users. While our original kit of seed cards only features plants which (by design) are very easy to plant (i.e. basil, chives, shallots, tomatoes, dill, carrots, chili peppers, parsley, and thyme), we have also imagined “extension packs” (very much in the vein of Pokemon cards) that could be targeted toward a specific user type’s wants and needs. So, if you wanted to plant an herb garden, perhaps you could buy a SeedMate “herb garden” expansion pack, which included biodegradable seed cards for cumin, paprika, and cilantro. Or perhaps you wanted to plant a garden which will produce vegetables for a certain ethnic cuisine, so you could buy a SeedMate extension pack complete with the vegetables directly suited to your family’s needs. While the prototype we created by the summer’s end is incredibly simple, the potential to extend it in any number of exciting directions is endless. One player that was involved in our user testing even commented that the card design was almost too beautiful and minimalistic to be planted - she was more interested in the possibility of seeing the cards as collectibles. All of this feedback points to the fact that despite (or perhaps because of) its simplicity, SeedMate seemed to strike a chord across multiple user groups and touch points. It fulfills a desperate need amongst the target, casual user demographic: a fun and easy way to learn to plant a garden.

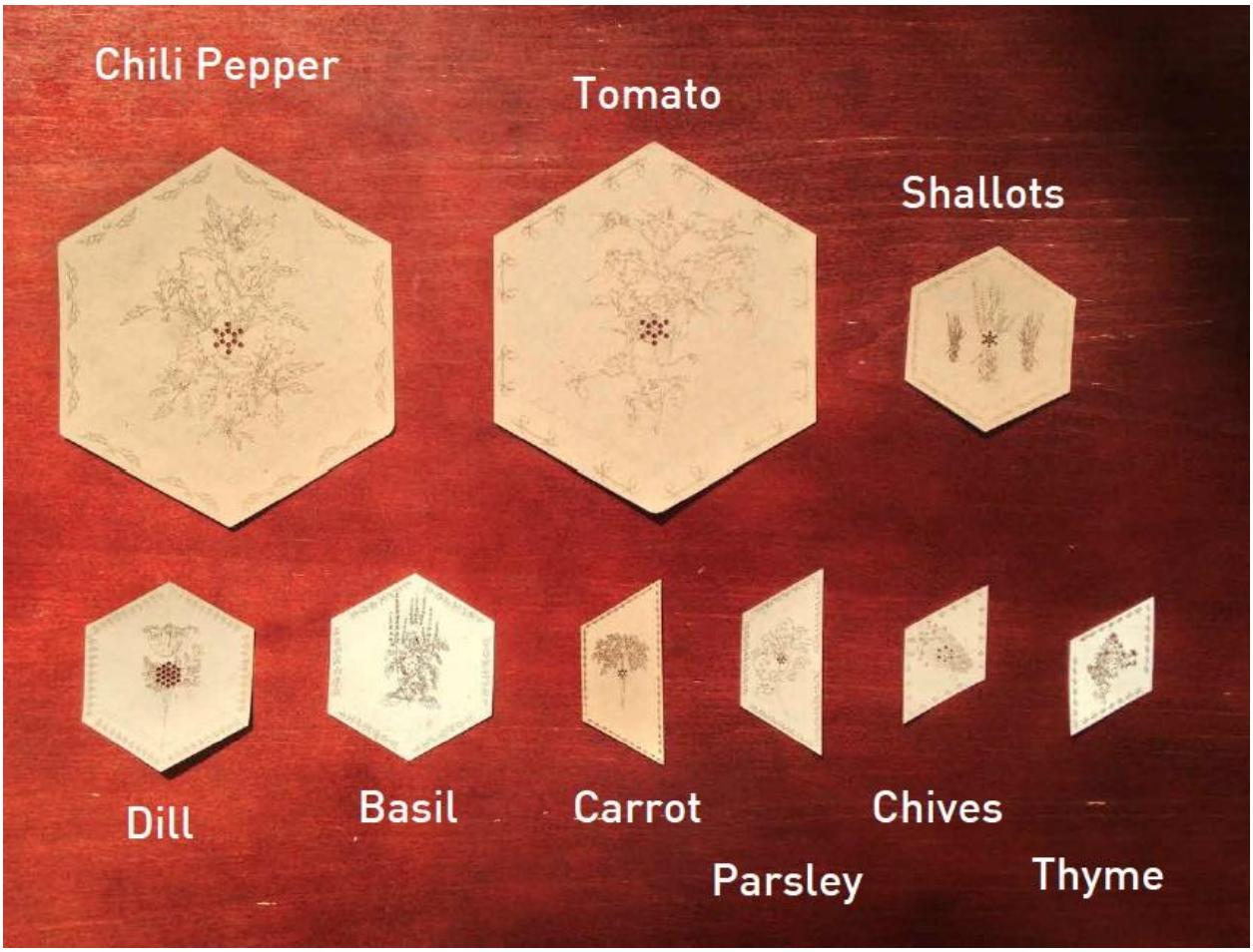

Figure 5.6 - Catalogue of seed cards that can be played and used for planting.

Final Thoughts

We began this project with nothing more than a problem statement: how do we create technologies to teach novice users about urban gardening? Besides a few initial suggestions for directions from our collaborators at RAI, we had no idea what concept would be produced at the project's end, much less any inkling of whether that prototype would be successful. However, by following the rigors of a user-centered design process, we were able to zero-in on our area of inquiry, identify the key players, issues, and trends, and create a technology to serve a specific need. For instance, in our trend research on experiential approaches to knowledge transmission using mobile phones, we identified a series of participatory video platforms and augmented reality apps which allowed people to tell or access stories, so that they might pass gardening knowledge from one generation to another. In our research on pragmatic approaches

to learning in ubicomp, we looked at sensor-based projects, as well as augmented reality apps for identification, in trying to parse out the ways in which different genres of ubiquitous computing could support different learning styles. Finally, in our ethnographic research with urban gardeners in Rome, Florence, and Milan, we were able to gather key big-picture insights about urban gardening in different cultural contexts, as well as insights into the specific educational and farming techniques used by professionals in the field. By synthesizing each of these research areas into a few digestible bits, we were able to brainstorm and prototype a concept within the span of a month.

Although the generation and prototyping of Seedmate was preceded by a tremendous amount of research, we hope that this book demonstrates the necessity of such conceptual work in crafting memorable ubiquitous computing user experiences. While technologies such as augmented reality historical applications, Tweeting begonias, and wearable computing all provide some amount of spectacle simply because of their novelty, their smart and useful deployment is always tied to good background research and a deep understanding of the context in which it will be employed. Though SeedMate may not be “infrastructural” and necessary in the way that Dourish and Bell describe large-scale, bureaucratically-implemented ubicomp systems, the game does represent an attempt to take the context, needs, wants, and educational styles of the casual user into account when creating a new concept for teaching them about gardening. SeedMate, thus, represents for us much more than a tangible object: it represents the process of thinking through the creation of a smart garden, filtered through the lens of user-centered design.

Figure 5.7 - Basil sprouts emerging from seed cards.

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