

**New Uses for Old Phones:
Upcycling the Rotary Dial Phone in the Age of the Smartphone**

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Abstract

Inspired, during a three month stay in India in the summer of 2012, by the ubiquity of the mobile phone in that country and its long and complex life span in contrast to the increasingly short life span of the mobile phone in the west, my research addresses questions of obsolescence, mobility, communications networks and innovation.

Initially grounded in the real-world conditions of rapid mobile phone obsolescence, my research subsequently adopted critical design and performance methods and culminated in two projects, *stereoPHONEic* and *textDLAL* that demonstrate ways to repurpose so-called obsolete rotary dial telephone hardware, combining it with other available technologies, and even human beings at times, to recreate smartphone functionality. Together with a literature review (addressing the mobile phone in India, ubiquitous computing, persistence versus obsolescence and actor-network-theory) and a survey of relevant art, design and performance work, this thesis describes the process and outcomes of my research.

Dedication

For Mom and Dad. Wouldn't they be
surprised to see me tinkering with code and
electronics.

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All Figures are by the author unless indicated otherwise.

Chapter 1

Introduction

Chapter One - Introduction

In 2010, Americans replaced their mobile device after one year and nine months, whereas Indians replaced their device after seven years and nine months and Brazilians after six years and eight months. (Entner 2)

If, in America in 2010, the average life span of a mobile phone was nineteen months, it is safe to say that it is even less today. In other parts of the world, however, the life span of the mobile phone is significantly longer and the life-story can be much more complex. For example, in a country like India, it is common for mobile phones to be bought and sold on the secondhand market and change hands a number of times over the course of their lives, trickling down to those who can't afford new. It is also common for phones to be repaired rather than replaced and, when they finally reach the end of their lives, to be harvested for parts to help support the phone repair market. In these countries, the long life span of the phone results in a well-established network of support service providers.

In many ways, the mobile phone represents the best and worst in digital technology. On the one hand, it has proved to be enormously popular in all parts of the world and has been particularly revolutionary in places that, previously, had little landline phone infrastructure and poor computer and Internet uptake. For many people in those areas, the mobile phone represented their first encounter with information and communication technology. On the other hand, the mobile phone is the fastest growing sector of electronic waste and thanks to the global flow of e-waste from developed to developing countries, is becoming an increasing environmental and health and safety problem. In the course of a three-month stay in India in the summer of 2012, I

observed many aspects of the Indian phone economy and developed a real appreciation for the impact of the mobile phone on that country. My choice of thesis topic was grounded in those experiences.

Background and motivation

This section describes my background and explains three increasingly specific motivations that led me to my research into new uses for old phones: what motivated me to enter a grad school digital technology program; what motivated me to travel to India in the summer of 2012; and what motivated my choice of research topic.

Born in the 1960s and trained as a professional architect in the era of drafting tables and typewriters, I am not what you would describe as a ‘digital native’. In my architecture practice, FORT architect inc. (www.FORTarchitect.com), I specialized in commercial, residential, heritage, sustainable and energy-efficient design, including, most notably, Building Blocks Homes (www.buildingblockshomes.ca), the winning design in the Archetype Sustainable Homes Competition, a national competition to design Canada’s greenest houses organized by the Toronto Regional Conservation Authority and the Design Exchange (done in partnership with Stonestrow Design Inc.).

My architectural training taught me that the tools we choose impact how we think and what we draw and make. Therefore, the following quote, commonly (but wrongly) attributed to Marshall McLuhan, always rang true to me: “we shape our tools and thereafter our tools shape us” (Logan). Over the course of twenty years of an architecture career, I have witnessed the growth of digital media and experienced the transition from manual to computer-aided design as well as its impact on my own work. Nevertheless, in some ways, for me, architecture was still a very bricks-and-mortar

discipline and not very different than it had been when I first graduated. Therefore, I realized that if I wanted more engagement with digital technology I wouldn't find it in my own practice and would have to look elsewhere.



Figure 1: Eight-year-old me on the Indian streets.
(Photo by dad, John Stevens)

What brought me to India in the summer of 2012? Having spent part of my childhood in India, I had always planned to return for a visit but, somehow, never managed to make it happen. Therefore, when the opportunity arose to do an internship at the Digital Empowerment Foundation (DEF) in Delhi as part of my Master's program, I jumped at it. Not only would it give me the chance to return to the country for a decent amount of time but, also, it would give me a grassroots work experience in a team context and a more immersive experience than the usual tourist trip.

I chose to focus on the mobile phone and explore ways to repurpose old phones as a direct result of my experiences in India, which exposed me to the sheer impact, ubiquity and long life span of the mobile phone in India. I also learned about the merits

of old technologies and simple interfaces; the enterprise and *chutzapah* (or its local, Hindi equivalent, *jugaad*) associated with the informal mobile phone economy; and that a phone is not just a black box but an extensive network of people, services and functions. On a more personal note, over the course of my stay in Delhi and my travels, I also gained a new appreciation of how great it was to travel with a smartphone and stay connected through social media.

Research question

The average life span of the mobile phone in the west is significantly shorter than in developing countries and thanks to planned obsolescence, aggressive marketing and the pace of technology change, the trend is for it to get even shorter. Mobile phone companies release new models every year (or more often), positioning every previous one as instantly obsolete — as though there are only two options, new and old or leading edge and obsolete, with no in-between — and reinforcing, in the process, the idea that innovation is all about replacing old stuff with new stuff. My first core research question, then, is when it comes to the mobile phone, is there an alternative to the trend of shrinking obsolescence cycles? If, for a person, a long life is a sign of a healthy life, couldn't the same be true of the mobile phone and our other technological artefacts? If so, what can we do to extend the life of the mobile phone and just how far can it be extended? Is an inclusive 'both/and' approach that blends and combines existing technologies an alternative to the more 'either/or' replacement cycles encouraged by planned obsolescence? My second core question has to do with what constitutes a mobile phone and how far can the definition be pushed? My last question is more

general: what can we learn in the process of this research, about innovation in the digital technology space?

Initial approach

I approached these research questions from a number of different directions. To start with I explored phones hands-on to learn how they worked and what parts could be re-used. I also investigated a number of other potentially useful digital platforms to see if they could be incorporated with phones. These explorations resulted in a number of small interactive pieces and helped establish a technical foundation in electronics and code.

Informed by my survey of art, design and performance work, I then began to experiment with a number of critical design methods, including provocation, irony and the inverted metaphor. This work marked an important turning point in my process: where my research stopped being so grounded in the Indian context and began to be much more abstract and performance-based; where it stopped being so much about finding concrete solutions to real world problems and began being more about making deliberately dysfunctional phones that enquired into the nature of the mobile phone and obsolescence. The two projects that resulted from this work, *stereoPHONEic* and *textDLAL*, were more substantial and complex than my earlier experiments and, as a result, went through several stages of prototyping, testing and iteration. Lastly, as the ironic and provocative dimensions of my projects grew, I incorporated performance into my work in order to experience them in the context of everyday public spaces.

Enter the rotary dial phone

Informed by my Indian experiences, my initial research focused on mobile phones, ranging from SMS-based ‘dumb’ phones to feature-rich smartphones. At the time, I was interested in questions such as how to constructively repurpose older text-based phones and, thereby, give them new leases on life. Before long, however, I began to understand the limits of dumb phone hardware. For example, I discovered that text/SMS and feature phones were like black boxes and offered frustratingly limited parts, sensors and affordances to work with. As a result, I expanded my scope of enquiry to include the rotary dial phone and discovered that, being fully mechanical and highly hack-able, they gave me a lot more to work with. On a conceptual level, combining rotary dial and smartphone technology also let me contrast analog and digital technology and mechanical and electronic hardware, which turned out to be both provocative and compelling. On a more personal note, there was also something I liked about using phones that dated from the 1960s and 1970s, not just because the fact that they were still working proved how impressively robust they were but because they corresponded to my own lifespan and, combined with smartphones, represented the arc of my own telephone experience. As a result of adding the rotary dial phone to my research, my question changed from how to constructively repurpose older text-based phones to how to give the rotary dial phone smartphone functionality.

Rotary phones that can play music or send texts may sound like technological follies and could be dismissed as useless novelty items or simple nostalgia. After all, it is already possible to buy an old-fashioned telephone handset that plugs into the audio jack of your iPhone (www.iphonehandsets.com), download a ringtone that sounds like a

vintage telephone or dress your phone up with steampunk accessories. What then, sets my research apart from these mobile phone accessories? To start with, those accessories prove the persistence of the rotary dial phone today, but replicate it in contemporary media such as an artificial-sounding digital ringtone or brightly coloured plastics. My projects, on the other hand, insist on using real phones, thus giving the user a first-hand experience of the real bulk of a phone and the real sound and resonance resulting from the metal bells inside it. Those iPhone accessories also never make you think beyond the mobile phone as a hardware device. My projects are designed to extend the notion of the mobile phone to include different types of technology and networks of human beings in distant locations.

There are, additionally, other implications of old phone technology that are worth mentioning briefly, but which are beyond the scope of this thesis: the use of legacy communication technologies during the Arab Spring when the authorities shut down the Internet, ICT4D (Information and Communication Technology for Development) applications, the subject of appropriate technology, environmental sustainability and even the open source movement.

Structure of the remainder of this document

The remainder of this thesis is structured as follows: Chapter Two, 'The Indian Mobile Phone Context', describes the observations I made regarding the mobile phone in India, as well as the problem of electronic waste, and how they informed my original research question. Chapter Three, 'Literature Review', establishes the critical context of my research and is organized around the themes of the mobile phone in India, ubiquitous computing, micro-enterprise and the informal economy, obsolescence and

actor-network-theory. Chapter Four, 'Art and Design Context', describes a number of relevant art, performance and design projects. Chapter Five, 'Design Research', describes my design work and research process. Chapter Six, 'Reflection', synthesises my design research with my original research questions, the themes identified in the literature review and the methods identified in the art and design context chapter. It also summarizes the outcomes of my research. Chapter Seven, 'Conclusion', wraps things up with an overall summary and identifies possible future directions. Appendix A provides additional information regarding my observations in India. Appendix B illustrates projects of the artists and designers discussed in the art and design context chapter. Lastly, Appendix C includes the code used in my electronic projects.

Chapter 2

The Indian Mobile Phone Context

Chapter Two - The Indian Mobile Phone Context

My initial thesis questions addressed ways to repurpose old mobile phone technology and extend the life span of the mobile phone and were a direct result of my experiences and observations in India in the summer of 2012. This chapter will provide an overview of those experiences for the purpose of contextualizing my early research.

The DEF's mission is to empower people "on the edge of information" (DEF). Its work takes many forms from providing Internet connectivity for isolated and under-serviced rural areas, to organizing awards and publications promoting grassroots ICT innovation, supporting community radio and advocating on issues of marginalization and sustainability. In order to improve awareness and decision-making at all levels (consumer, large and small businesses and government), DEF conducted a horizontal study of the mobile phone, with an emphasis on grassroots-level initiatives and the informal sector of the economy. Topics included secondhand phone markets, mobile phone repair shops, inexpensive copycat and counterfeit phones and grassroots organizations that use old phones and simple interfaces for empowerment purposes. Additionally, the study addressed the problem of mobile phone e-waste handling in light of the government's brand new e-waste handling regulations, which had been introduced that spring. This chapter describes the outcomes of that study that informed my initial choice of research questions. It is divided into three sections: the mobile phone economy, the merits of the long life span of the mobile phone and electronic waste. See Appendix A for additional details regarding scope, methods and observations.

The mobile phone economy

When it comes to describing the mobile phone economy in India, categories such as formal economy/informal economy, legal/illegal and local/global are oversimplifications. The informal and formal economies in India are neither mutually exclusive nor discreet domains (Rangaswamy 559). We observed examples of how, in some circumstances, they seemed to be deeply interdependent and enmeshed with each other and how, in others, they seemed to compete and clash. Especially at the micro-enterprise level, individual operators in the informal grey market operate in a fuzzy zone where the legal and illegal and the formal and informal overlap, and move from one to the other as conditions of supply and demand dictate. Similarly, it is not just large companies and multi-nationals that participate in global flows of trade and technology. Even small- and micro-entrepreneurs traded in phones, parts and e-scrap with China.

The Indian mobile phone landscape is more diverse and layered than the Canadian. Markets such as Nehru Place Market and Gaffar Market, in Delhi, consist of large name-brand stores, smaller independent shops, even smaller businesses housed in modest counters or display cases on rented sidewalk space in front of the shops, and sales people hawking their wares on foot. From our observations, the net result for the consumer was a diverse range of options of sales (new name brands, secondhand, new Indian copycat brands, refurbished phones, China-made small-name products and outright counterfeits), services (repairs, name brand parts, refurbished parts, knock-offs, pirated software, re-charging and accessories) and price-points that help make mobile phones much more accessible to a variety of people in India.

The merits of the long life span of the mobile phone

In addition to helping make the mobile phone accessible, even to people seemingly below the poverty line, the ubiquity of secondhand phone and repair shops also contributes to the long life span of the Indian mobile phone, thanks to which, Indian mobile phones continue to be valuable long after they would have been relegated to the trash heap in North America. In the Indian context, older, simpler ‘dumb’ phones offer a number of advantages.

Unreliable electrical service and frequent blackouts and brownouts make a mobile phone more practical than a computer, especially for the poor. A text-based phone whose battery can hold a charge for a week, furthermore, is especially practical for people with limited access to electricity. Older phones with simpler interfaces are also easier to learn for people with limited literacy and numeracy.

Inexpensive phones with simple interfaces are also used for empowerment purposes. For example, EKO Services (<http://eko.co.in>) provides basic banking services (deposit, withdrawal and secure money transfer) to the previously unbanked: the poor, the migrant worker, the innumerate and the illiterate. Requiring only touch-tone dial functionality, EKO transactions are designed to work on the most basic handset, with an interface that would be familiar to anyone who has ever recharged their phone. According to Anupam Varghese, of EKO Services, last year it had over 180,000 users and handled Rs. 400 crore (\$800,000) in transactions (Varghese). Reuters Market Light (www.reutersmarketlight.com) is another example of an application specifically designed for lowest common denominator phone handsets, to make local and personalized agricultural information available to Indian farmers who previously had to rely on word

of mouth or the word of self-interested middlemen and traders (Singh). Additional details and other examples can be found in Appendix A.

The long life span of the mobile phone, combined with the range of product availability and price point contributes to the overall popularity and accessibility of the mobile phone in India.

Electronic waste

The subject of e-waste handling offers another example of how the official and the unofficial economies happily co-existed. In India, the vast majority of garbage collection has always been handled by a bottom-up network of local *kabadivalas* (independent rag-pickers who collect and sort household waste at the neighbourhood or even building level, separate out the e-waste and other recyclable materials and sell it on to aggregators). This system has always employed millions of people and, presumably, relieved governments and municipalities of having to provide garbage collection services. According to much-cited statistics from the Manufacturer's Association for Information Technology (MAIT), 95% of all e-waste in India is handled in the informal market and only 5% handled by industrialized recyclers (MAIT GTZ). Furthermore, according to Priti Mahesh of Toxics Link, a Delhi-based NGO working to reduce industrial pollution (www.toxicslink.org), and Anuj Maheshwari of Ecoreco, a Mumbai-based industrialized e-waste company (ecoreco.com/index.html), India's industrial e-waste companies typically operate well under capacity because they simply can't compete with the established informal market in terms of cost and access to raw materials (Mahesh, Maheshwari).

As a result of growing environmental and health-safety concerns associated with informal e-waste processing practices, in May of 2012 the Indian Government introduced its first-ever set of regulations to govern the collection, processing and recycling of e-waste. The new regulations mandate fully formalized and fully industrialized e-waste handling but make no provisions for the millions that will be displaced if and when the regulations take hold. Some people, however, believe that it is possible to take a more pragmatic, nuanced and inclusive approach to the problem of electronic waste; one that achieves the same environmental goal, but avoids the potential social disaster of displacing so many people. Chintan (chintan-india.org), for example, is a Delhi-based grassroots organization that works on behalf of rag pickers and people working in the informal e-waste economy by organizing them so that they can work with the industrialized waste companies, rather than compete against them (Mahesh). Sandeep Chatterjee, with the Ministry of Information Technology, furthermore, has developed a different model that incorporates both the informal and formal sectors, in such a way that each does what it is best suited to do and neither loses its current market share (Chatterjee). In his model, informal workers would continue to collect, sort and disassemble non-toxic components but all potentially toxic or dangerous work would be carried out in highly controlled and mechanized industrialized facilities. The new e-waste regulations, however, are not designed to accommodate the informal sector into the formal sector but to entirely replace the one with the other. Chintan's and Chatterjee's approaches, by contrast, are designed to be inclusive, incorporating *both* the established informal *and* the newer industrial e-waste sectors.

A second potential risk associated with the new e-waste regulations, assuming they come into effect as designed, is that they could short-circuit the existing flow of

secondhand phones into the marketplace by bypassing the secondhand and refurbishment markets and diverting used phones directly to the industrial recyclers. This would reduce the availability of older, less expensive phones for the poor and for organizations that use them for empowerment purposes. It would also, effectively, contribute to the shrinking life span of the Indian mobile phone.

My experiences in India helped me develop a new appreciation for the long life span of the mobile phone, the value of old technology and equipment and what helps make the mobile phone so accessible in India. It helped me understand the mobile phone as a complex and extended network of people and service providers in a way that isn't as apparent in contemporary Canada. It also helped me understand the complexity of the e-waste problem and the relationship between the formal and informal economies. It was these real-world, context-based problems that led to my choice of thesis topic and informed my sensibilities regarding the challenges and merits of blending the old with the new.

Chapter 3

Literature Review

Chapter Three – Literature Review

In order to better inform my research by current discourse, I reviewed contemporary literature on a number of relevant subjects. This chapter outlines these subjects and identifies key concepts that played into my design work. The first two sections — ubiquitous computing and the mobile phone in India — start on separate tracks but converge with the assertions that ubiquitous computing arrived in the form of the mobile phone and that this position is especially true of the mobile phone in developing world countries such as India. The next sections address a number of related sub-themes: messy infrastructure, seams, micro-enterprise and the informal economy, ubiquitous computing in the here-and-now rather than the future, and ubiquitous computing as a social and cultural phenomenon rather than purely a computer science one. The last two sections address obsolescence and technological systems as networks of both human and technical actors.

Ubiquitous computing

The term ‘ubiquitous computing’ (also known as ‘UbiComp’) was coined by Mark Weiser, chief computer scientist at Xerox PARC, in his 1991 *Popular Science* article: “The Computer for the 21st Century.” The article introduced a number of key UbiComp concepts that are still current today, such as sensors and computation built into the environment, seamlessness and calm computing. According to Weiser, in the PC-model of computing, the computer is always in the foreground, distracting end-users by forcing them to contend with its jargon, code, file-names, protocols or virtual reality paraphernalia and generally getting in the way of what they are actually trying to do

(Weiser 20). In the future, however, computing would be freed from the confines of the desktop PC. Ubiquitous and everyday, computation would blend into the background, thus enabling users to concentrate on what they really want to do, wherever they actually were (and it certainly wouldn't be stuck at a desk in front of a personal computer) and whomever they were with (Weiser 25).

Built into every place and every thing, computation would flourish and, naturally, it would all work seamlessly. Because the apparatus of ubiquitous computing would be invisible, the end user's experience of it would be calm, smooth and effortless — possibly even banal. Weiser likened it to wearing a good pair of eyeglasses, in other words, something transparent and supremely practical, that you didn't really have to think about but which helped you with the task at hand (Galloway 386, Greenfield 11).

Weiser's article has had a long legacy in computer science and UbiComp literature. In the 2006 book *Everyware: the Dawning Age of Ubiquitous Computing*, Adam Greenfield coined the term 'Everyware' to capture the spirit of what he saw as the imminent and inevitable future of computing. He wrote: "Everyware is an attempt to describe the form computing will take in the next few years. Specifically, it's about a vision of processing power so distributed throughout the environment that computers per se effectively disappear" (Greenfield 1). In his 'Everyware' future, computers and computation would be embedded in all places, public and private, and most things (i.e. the Internet of Things). They would work smoothly, feel natural and always operate in the background or just under the surface of awareness:

There are powerful informatics underlying the apparent simplicity of the experience, but they never breach the surface of awareness: things Just Work. Rather than being filtered through the clumsy arcana of applications and files and sites, interactions with 'Everyware' feel natural, spontaneous, and human. Ordinary people finally get to benefit from the full power of information

technology, without having to absorb the esoteric bodies of knowledge on which it depends. And the sensation of use—even while managing an unceasing and torrential flow of data—is one of calm, of relaxed mastery. (Greenfield 1)

For both Greenfield and Weiser, then, ubiquitous computing would be so well embedded into the environment (appliances, rooms, buildings, public spaces, civil engineering infrastructure) that it would free people from being tethered to their desktop computers, give them always-connected mobility and render the personal computer obsolete. In the context of this paper on the mobile phone, it is worth noting that neither Weiser nor Greenfield had the mobile phone in mind when they talked about UbiComp. For Weiser, this is understandable, of course, because he passed away before the mobile phone revolution. Greenfield, on the other hand, classified both the mobile phone and the personal computer as devices that “can be switched off or left at home” (Greenfield 6) as opposed to UbiComp, which he saw as “ambient, ubiquitous, capable of insinuating itself into all the apertures everyday life affords it” (Greenfield 6) and, therefore, something that people did not have the power to turn on or off. Furthermore, UbiComp promised smooth, invisible and unconscious functionality that “Just Work(ed)” (Greenfield 1) — something that clearly wasn’t yet the case for Greenfield in 2006 and still isn’t for us in 2013. The ‘Everyware’ world that Greenfield described was a top-down, Big Computer Science world where UbiComp is everywhere, invisible, always-on and placeless, as is implied in the very term ‘Everyware’ (as in everywhere but nowhere).

The mobile phone in India

The mobile phone is the most disruptive device to come to India in modern times. It disturbs more people and relationships than the printing press, the watch or the automobile, though it has the qualities of all three. Like the printing

press, it allows people to communicate their ideas; but unlike the press, literacy is not necessary, and hundreds of millions of people can disseminate any idea they like from their mobile phone. Like the watch, the mobile phone can be used to enforce discipline about punctuality, but it gives its owner so many more possibilities than simply the ability not to be late for an employer's deadline or to enforce timeliness on others. Like the automobile, the mobile phone allows communication over distance; but unlike the automobile, mobile phones are cheap and do not occupy the space of a large cowshed. An automobile allows a few people to travel considerable distances; a mobile phone allows any number of people to communicate with others almost anywhere in the world. (Jeffrey and Doron 397)

In "Celling India: Exploring a Society's Embrace of the Mobile Phone" Assa Doron and Robin Jeffrey describe the growth of telephony in India in the last two decades as revolutionary in both scale and disruptiveness. According to their statistics, in 1987, there were 2.7 million telephones in India, equivalent to a 0.3% phone penetration (399). The first mobile phone and Internet services became available in 1995, but only for the wealthiest people in a limited number of cities. Penetration increased in the next five years as a result of liberalization, privatization and foreign investment but by 1999 total phone penetration was still only 2% of the population (399). Mobile phone sales really took off after the year 2000 when prices dropped due to licensing changes (402) and by 2012, mobile phone penetration stood at 75% (TRAI), which put it at about the world average and slightly ahead of Canada at only 74%, (CWTA). Today, Indians have access to a wide range of both domestic- and foreign-made phones and, arguably, the most affordable mobile phone rates in the world combined with flexible prepaid plans that make contracts all but unnecessary.

India's mobile phone revolution is more than simple statistical growth, deep penetration and low service costs. It is also the story of how the mobile phone penetrated to all levels of society, gave so many people their first contact with

information and communication technology of any kind and disrupted the status quo of political power and the marketplace. It is a well-known fact that even the very poor will spend a disproportionate amount of their income on a mobile phone or come up with workarounds (phone sharing, dual SIM card phones, dropped call codes, etc.) to make ownership feasible. In fact, the mobile phone has had a bigger impact on all levels of Indian society than the personal computer and the Internet combined, neither of which ever enjoyed the same popularity or uptake. Affordable and seemingly ubiquitous — even for those considered below the poverty line (BPL) — in just a few years the mobile phone has given people unprecedented access to information and to each other, spawned an entire industry of formal- and informal-sector support service entrepreneurs and, in some cases, changed the balance of power between the powerless and the gatekeepers. Jeffrey and Doron again:

Between (the) people at the top and those people near the bottom, new workforces of manufacturers, technicians, tower builders, distributors, agents, marketers, salespeople, repairers, recyclers and secondhand dealers take shape. And even poor people can own cell phones. At the base of the pyramid, we hear stories of fishermen and farmers, rickshaw drivers and vegetable sellers, making ‘missed calls’, taking pictures, checking prices, downloading screen savers, doing pujas – all with a device that would have mystified most of India before the year 2003. More important, the cell phone appears to arm its owner with possibilities to leap over barriers, not merely of distance but of power. The cell phone does not eradicate power structures, but it can sometimes subvert them. (Jeffrey and Doron 398)

Jeffrey and Doron argue that the mobile phone provides both economic opportunities and political agency, especially for previously marginalized groups. It gives access to real-time market information for isolated farmers and fishermen (Jeffrey and Doron 412); it offers a wide range of micro-enterprise business opportunities for castes traditionally excluded from commerce (Jeffrey and Doron 409) and it enables the politically disenfranchised. For example, the mobile phone is credited with enabling the

Dalit underclass in Uttar Pradesh to out-organize the usual party players and win the State elections in 2007 for the first time ever (Jeffrey and Doron 411). What is important in this example, is that it was not the mobile phone itself that was innovative (because, of course, the incumbents had mobiles too, and probably better ones) it was how the mobile phone was used that was innovative. In other words, it is an example of how innovation is not limited to hardware developments and not necessarily a top-down process.

Messy infrastructure

Two things that characterize the mobile phone in India are poor infrastructure and an informal micro-economy. In “Cutting Chai, Jugaad and Here Pheri: Towards UbiComp for a Global Community”, Nimmi Rangaswamy describes practices of mobile phone ownership in urban slum areas of Mumbai and Bangalore as well as the micro- and small-enterprise economy that surrounds and supports the mobile phone, characterizing both as ubiquitous (599). The Indian urban ICT landscape is a messy and imperfect combination of pent-up desire for everything the mobile phone has to offer (music, movies, networks, source of income, status, etc.) combined with unstable and discontinuous infrastructure (Internet, electricity, water), dated and sometimes dysfunctional ICT hardware, mixed levels of literacy and numeracy and a well-established and highly entrepreneurial grey market economy. Like many locations in the global south, a combination of limited resources, bottom-up micro-entrepreneurship and unstable and messy infrastructure transform ubiquitous communication technologies into something quite different from the flawless vision “of a technological future of clean and gleaming infrastructures seamlessly providing well-designed services (in the

north/west)” (Rangaswamy 553) as suggested in the UbiComp literature of Weiser and Greenfield.

In the everyday reality of “low-income (Indian) communities” she continues, “heterogeneity is visible everywhere — in ... varying informational needs, literacy levels, numeracy levels, or digital literacy levels” (Rangaswamy 562). Designers and decision-makers would do well to re-align their work to these types of conditions: to design for constrained conditions rather than plenty, messiness rather than ideal conditions, heterogeneity rather than uniformity; to design for innovation and adaptation of existing technologies rather than introducing expensive new ones; to design for multiple adaptive user-interfaces and a range of capabilities rather than restricting the users’ options with ‘black-boxes’; and to design equipment for re-use rather than planned obsolescence (Rangaswamy 562).

I believe that the real-world challenges that Rangaswamy addresses to designers and computer scientists are critical in the twenty-first century for reasons of environmental sustainability and equal access to information technology. Arguably, they are also more pragmatic and realistic than the vision of a seamlessly perfect UbiComp.

Rangaswamy describes mobile phone infrastructure as ‘messy’. Paul Dourish and Genevieve Bell (who Rangaswamy references) discuss messiness at length in *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*, going so far as to say that all infrastructure is inherently messy and to champion messiness over tidiness. The reality, they argue, is that infrastructures of all types, not just computer infrastructure, are, by nature, uneven, discontinuous and full of seams, fault lines and gaps. The reasons for this are many. First, infrastructure is built and expanded slowly and incrementally over time rather than all at once and, as a result, is made up of a variety of technologies and

materials of different vintages. Second, economic disparities; different languages, protocols and literacy levels; commercial competition in the marketplace, human nature, politics and protectionism — conditions that are not likely to go away — mean that high-quality uniform infrastructure is not very realistic. “Messiness,” according to Dourish and Bell, “is a property of infrastructure itself. Infrastructures are inherently uneven in their operation and availability. The notion of a seamless and uniform infrastructure is at best a chimera” (26). Messiness and seamfulness, therefore, are inherent to computer infrastructure and it is futile to try to eliminate them from UbiComp. But more than that, messiness is something to be embraced not eliminated; it is compelling, thought provoking and a source of creativity and invention, rather than a sign of failure or an obstacle to success:

Yet we are not implying that the messiness is an obstacle, nor are we proposing that it would be appropriate to tidy up. We find messiness inspiring, productive, generative, and engaging. Tidiness is static, rigid, fixed and closed; messiness is dynamic, adaptive, fluid and open. Likewise, when we talk about the problems of ubiquity and the impossibilities of erasing difference, we do not see these as nails in UbiComp’s coffin but rather as points of interest and exploration. Cleaning things up has, in short, neither been our goal here nor has it become our goal going forward; embracing the messiness gives us so much more to think about. (Dourish and Bell 93)

For Dourish and Bell, the challenge for designers is not to clean up messiness and eliminate difference but to embrace messiness and to deliberately incorporate difference.

Seams

In UbiComp discourse, the debate between tidiness and messiness parallels that between seamlessness and seamfulness. Ever since Weiser, the future UbiComp world has been described as seamless, smooth, calm, invisible and operating below the level of consciousness. Matthew Chalmers is one author who took issue with the concept of

seamlessness and argued instead for deliberately seamful design. According to his paper, “Seamful Design and UbiComp Infrastructure,” by 1994 Weiser had changed his mind about the merits of seamlessness and invisibility and had begun to describe seamlessness as a “misleading or misguided concept” because it reduces everything to the lowest common denominator and favours “bland compatibility” over rich experience and specialized functionality (1). Instead, Weiser began to lobby for “‘seamful’ systems (with ‘beautiful seams’) as a goal” (Chalmers 1). By seamful systems, he meant environments and smart objects that contained multiple, local, agile and customized systems all coexisting happily with each other. In fact, the more local systems or smart objects, the more seams, the better (Chalmers 2).

According to Chalmers, however, even though Weiser abandoned the idea of seamless computer systems, he still held onto the goal of seamless user experience across those systems, or in other words, seamless and unbroken movement between different — but compatible — integrated systems and tools (Chalmers and McColl 2). By contrast, Chalmers argued that seams between, and edges of, systems should be as conspicuous and visible as possible. Seamlessness, he said, has the same inherent risks as invisibility: if you can’t tell that you’ve just crossed a surveillance threshold, then you have no way of opting out, turning off or turning around. Seamful computing, by contrast, makes the seams, edge conditions, interstices and interference zones between systems as visible, tangible, knowable and locatable as possible. For example, he designed a ‘seamful game’ that challenged players in the vicinity of the university campus’ wireless network system to navigate the edge of the network field in order to complete tasks and score points. Not only did the game raise awareness of the extent of the network field, but also it gave the players a handle to grasp the otherwise invisible

wireless computer system. Chalmers observed that when players learned to take advantage of the edge conditions and supposed weak points in the computer system they began to really master the game (Chalmers and MacColl 2). This is crux of the matter to Chalmers: it is precisely these edges, seams, flaws and supposed weakness that start to make systems visible and understandable to the user. Additionally, visibility and comprehension empower and protect people in the face of surveillance and abuses of privacy. What might seem from a computer science angle like flaws or shortcomings in the infrastructure, therefore, could equally be understood as interface opportunities when seen from a different angle.

Dourish and Bell argued that messiness is inherent to UbiComp and, furthermore, something to be embraced rather than tidied up. Rangaswamy argued that designers should design for the messy and seamful conditions of today. Chalmers, argued that seamlessness and invisibility are potentially dangerous and, therefore, systems should be deliberately designed to have conspicuous seams. Together, they depart from the Weiser's original vision of seamlessness and calm computing and Greenfield's vision of 'Everyware'.

Today's smartphones do a seemingly ever-increasing number of things with ease and, as a result, it is easy to take them for granted. In other words, as long as they work, there is no need to look closer at them. My own phone projects, *stereoPHONEic* and *textDIAL*, by contrast, are deliberately designed to be seamful, messy and dysfunctional, in the sense that they mix mechanical, digital and human elements and have limited functionality. It is the apparent shortcomings and absurdity of their propositions that forces the user to look and think twice about something they may have taken for granted before.

Micro-enterprise and the informal economy

The second characteristic of the Indian mobile phone landscape, according to Rangaswamy, is the thriving micro-enterprise informal economy. Much has been written about the ingenuity and enterprise found in informal and micro-enterprise economies in various parts of the world

There is overwhelming public evidence of information technology existing in nook mom and pop businesses of (re)selling, (re)assembling, (re)cycling and (re)servicing ICTs. It provokes attention toward the flourishing and ubiquitous non-formal or gray markets in India working with sparse and unstable infrastructural resources, kindled by human endeavor and dynamism. In contrast to the popular UbiComp view of infrastructure as given by corporate entities, infrastructures in low-income or resource constrained environments often involve the work of several actors and networks in filling gaps in more formal infrastructures, channeling information, communication, and basic necessities of everyday life. (Rangaswamy 559)

The resulting counter- or informal-economy, she argues, is characterized by micro-scale businesses, high-density conditions, poor infrastructure, human ingenuity and adaptive entrepreneurial strategies that she calls ‘intermediaries’. I prefer to simply call them ‘workarounds’. Specifically, the three she identifies are:

- ‘Cutting Chai’: literally, splitting the cost of a cup of tea (already one of the least expensive and most ubiquitous types of street food), the metaphor refers to creative and ingenious strategies for getting what you want without paying full price. An example would be people sharing a double- or triple-SIM card phone (Rangaswamy 557).
- ‘Jugaad’: innovative and often low-cost solutions borne out of necessity. In the Indian context, the term is a compliment that implies canny resourcefulness. An example would be extending the life of the mobile phone well beyond the norm, through re-use, repair and the trade in parts (Rangaswamy 558) or home-made (and often unsafe) means to strip the gold and copper from dead circuit boards. Re-purposing technologies would also fall into this category (Rangaswamy 558).
- ‘Here Pheri’: grey market, semi-legal practices; getting away with whatever you can (Rangaswamy 559). Examples include subverting authority, the law, intellectual property rights or conditions imposed by Big Telecom (fees, contracts, limited licenses, designed incompatibility, forced upgrades, etc.),

appropriation, counterfeiting and deliberately making ‘missed calls’ or ‘dropped calls’ to avoid phone charges.

Even though the urban poor may lack financial capital and ideal physical infrastructure, the dense urban conditions that they operate in create human and social capital and economies of scale that support and enable the informal economy. For example, high density concentrated hot spots (i.e. slum neighbourhoods and markets dedicated to a particular type of product or service) create enough critical mass and competition for a high-volume low-margin business to thrive and help keep prices affordable. They also allow a large number of people to specialize in niche services, thereby reducing the training and investment required for each one to get started (Rangaswamy 559), but adding up to a fully-established and comprehensive network of services (Rangaswamy 560). In this way, the micro-enterprise economy:

makes the economy more inclusive, providing several thousand jobs. The effects are profound. What was once regulated to the urban elite, through formal distribution channels and centralized market places, is now decentralized, democratized and decoupled from the central market.” (Rangaswamy 560)

Like Jeffrey and Doron, Rangaswamy argues that the mobile phone and all its multifaceted support services helped decentralize and democratize the marketplace and shift the balance of economic power.

(See the design research chapter for a description of how my *Upcycling #1: Really Smart Phone* project concept incorporated the phenomenon of high-volume niche-services that Rangaswamy identified.)

Ubiquitous computing today, not tomorrow

Like many developing countries, India never enjoyed reliable or widespread landline phone infrastructure or widespread PC ownership and Internet access, but seemingly leapfrogged directly to a state of ubiquitous mobile phone penetration (as Jeffrey and Doron's statistics above attest). Rangaswamy, furthermore, argued that in locations such as India, the mobile phone is the "UbiComp of the present" (Rangaswamy 555). Paul Dourish and Genevieve Bell drive this point home in *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*. One of the many myths they associate with ubiquitous computing is that of the 'proximate future'. Ever since Wieser, they argue, ubiquitous computing has always been positioned as something belonging in a near future world — just around the corner, but not here yet; something that, in their opinion, gives computer science an excuse for turning a blind eye to the reality of everyday conditions for most of the world and for avoiding addressing those issues (Dourish and Bell 20). In reality, they argue, UbiComp has already come to pass and much of what the computer scientists speculated about the future of computing (Weiser's networked offices, for example) is already here: "many aspects of the original UbiComp research vision are mundane realities for people throughout the world; what was once research imaginary is now commonplace and unremarkable" (Dourish and Bell 21). The era of ubiquitous computing was ushered in by mobile technologies, something that is especially true for the developing world where landline phone and personal computing were never as well established as in the developed world.

First, the centrality of UbiComp's proximate future continually places its achievements out of reach, while at the same time blinding us to the current practice. By concentrating on the future just around the corner, UbiComp renders contemporary practice ... by definition irrelevant or at the least already

outmoded. Arguably, however, UbiComp is already here; it simply has not taken the form that we originally envisaged and continue to conjure in our visions of tomorrow. (Dourish and Bell 22)

The future of ubiquitous computing, they argue, has already arrived — just not in the form that computer science anticipated, because it arrived in the form of the mobile phone rather than the built-in, placeless, invisible, always-on vision of Weiser's UbiComp or Greenfield's 'Everyware'.

In my lifetime I have experienced an evolution of phone and computer technologies, starting with the landline phone, then computers and fax machines, then the Internet and then a range of mobile phones. In India, however, I experienced first-hand the sheer impact and penetration of the mobile phone and developed a new appreciation for it. As a result of these experiences, Dourish and Bell's arguments that ubiquitous computing has already arrived in the form of the mobile phone and that we need to re-focus our sight on a UbiComp of today, not tomorrow, really rang true.

The social and cultural dimensions of UbiComp

The failure to recognize the arrival of ubiquitous computing, according to Dourish and Bell, is partially the result of two additional biases in ubiquitous computing: first, a northern/western world bias that is blind to conditions in much of the rest of the world (ROW) and, second, a computer science bias that tends to be dazzled by the possibilities of the future; that takes a very technical and instrumental approach to the subject; and that leaves out the human, cultural, sociological and contextual dimensions of computing:

We need to look beyond a technical and instrumental account of mobility. When we think of mobility in strictly technical terms, we think of topics such as bandwidth, resource management, location, and wireless networks. But when

we think of mobility in social or cultural terms, a different set of topics comes into view: pilgrimage and religious practice, globalization and economic disparities, migration and cultural identity, and daily commutes and the suburbanization of cities. How these various elements are configured and reconfigured is subject to constant negotiation, including even the ongoing one of individual identity. Different places demand different forms of behaviour, yet mobile technology suggests the possibility of a constant, fixed expectation about who one is and one's level of accessibility and engagement. (118)

Dourish and Bell argue, instead, for a less scientific and more ethnographic approach to the study of ubiquitous computing and mobile technologies — one that includes social and cultural practice, place, local adaptation and difference rather than one that focuses on universal conditions of computer technology and infrastructure:

UbiComp has turned out to be characterized by improvisation and appropriation; technologies lashed together and maintained in synch only through considerable efforts; surprising appropriations of technology for purposes never imagined by their inventors and often radically opposed to them; widely different social, cultural and legislative interpretations of the goals of technology; and flex, slop and play. (Dourish and Bell 92)

Rangaswamy, similarly, took an ethnographic approach to her study of mobile phones in Indian cities, describing practices of owning, sharing, repairing, refurbishing, reselling. In doing so, she effectively expanded the definition of the mobile phone to include networks of people and businesses on both the supply and demand sides. She reinforced the point that the mobile phone is much more than the hardware device in your hand; it is a large network of supply chains, people and distribution networks — something that, from my experience, is more apparent in India than in Canada, as previously mentioned. To cite a couple of personal examples, in Canada, I have a mobile phone plan that automatically renews every month. In India, by contrast, I had to go in person to a shop to get my phone recharged and, as a result, I regularly came into personal contact with some of the micro-service providers. Second, because of the scale and concentration of micro-enterprise businesses in mobile phone markets and

hotspots such as Nehru place, the networks of related support service providers are highly visible and easy to grasp. In Canada, by contrast, these networks are much less obvious.

From Obsolescence to Persistence



Figure 2: A 2013 Comwave Internet phone ad, ironically featuring a rotary dial phone

According to Marshall McLuhan's theory of the tetrad of media effects, every new medium obsolesces an old one (NFB). Computer and mobile phone marketing, furthermore, relies on the suggestion that even last year's models are obsolete. The concept of persistence, however, gives us an alternative approach to the subject of technological change. Charles Acland describes persistent media in his introduction to a book of collected essays called *Residual Media*. Borrowing Raymond Williams's taxonomy of emergent, dominant and persistent media, persistence is the continued presence of past in the present (Acland xxi). Examples of the persistence of old telephones in contemporary culture would be the use of the rotary dial phone icon in recent ads for Comwave internet phone (See Figure 2), the popularity of cell phone ringtones that sound like vintage telephones, the retro phone handset complete with

curly cord iPhone accessory (www.iphonehandsets.com), Sparkfun's 'Port-O-Rotary' rotary dial cell phone (www.sparkfun.com/products/286?) and, on a more serious note, the reliance on legacy phone technologies such as fax, landlines and dial-up modems during the Arab Spring when Internet service was shut down by the authorities. In William's taxonomy, 'Archaic' media are dead media belonging fully in the past (Acland xxi). The telegraph, then, would be considered archaic rather than persistent today. Acland argues that Williams's emergent/dominant/persistent media model is more nuanced and useful for describing technological and cultural change than simply thinking in terms of fixed and mutually exclusive categories such as new versus obsolete. "In sum", he writes, "Williams's dynamic model throws a wrench into the impression of the smooth dynastic sweep of social change, whatever the motivating force" (Acland xxi). He calls Williams's model dynamic because the co-existence of dominant and persistent media in any given present creates a tension and play between the two. Classifying things as simply new versus obsolete, by contrast, is much more simplistic, static and permanent.

With "the smooth dynastic sweep of social change" Acland also references a one-way deterministic idea of progress as a constant movement forward; a continuous adoption of what is new (and, of course, *better* than before); and as a clean rupture with the past. To Acland, this narrative of progress is a myth:

"If there is a reigning myth of media, it is that technological change necessarily involves the 'new' and consists solely of rupture from the past. This preoccupation neglects the crucial role of continuity in historical processes as well as the accumulation and accommodation just described. It ignores the way the dynamics of culture bump along unevenly, dragging the familiar into novel contexts. (Acland xix)

Change is bumpy and sometimes unpredictable rather than smooth and one-directional. Change, furthermore, can involve re-inventing the old in new contexts as much as inventing the new.

In “Out with the Trash,” Jonathan Sterne explores obsolescence and planned obsolescence in the computer industry. Whereas obsolescence, he says, once referred to “genuine innovation, utility and, to some extent, necessity” (Sterne 21), planned obsolescence has come to mean a kind of contrived or even “forced” (Sterne 22) obsolescence deliberately engineered into manufactured products. Obsolescence can be subdivided into two types: technological and stylistic obsolescence (Sterne 20). Of course technological obsolescence has existed as long as humans have had tools, but in the modern era it has become a key part of modernity’s narratives of progress: a clean break from the past and the perfectibility of man (Sterne 21). Stylistic obsolescence, (i.e. planned obsolescence) on the other hand, had its origins in twentieth century industrial manufacturing (the automobile, appliances) in America and arose as a way for manufacturers to encourage people to replace their expensive belongings even if they were still operational and, in the process, to boost sales. More recently, the computer industry (and, by extension, the mobile phone industry) has applied the logic of planned obsolescence so well that equipment replacement cycles are shorter than ever before:

So what makes computer obsolescence important, different, or new? The answer is that the computer industry has applied the logic of planned obsolescence to media hardware more thoroughly than any other media industry before it. Computers and digital media are no longer ‘new’ with respect to other media. They are new primarily with respect to themselves. (Sterne 22)

Engineered obsolescence, such as limited backward compatibility, combined with aggressive marketing campaigns that position even last year’s phone models as obsolete,

has resulted in the 18-month (or less) replacement cycles that have been noted in the west, as well as a growing mountain of electronic waste.

My own projects rely heavily on the notion of the rotary dial telephone as a persistent rather than obsolete technology. In fact, if the rotary dial telephone wasn't so persistent, the projects would be relatively flat and uninteresting.

Human/technological networks

In "Where are the Missing Masses? The Sociology of a Few Mundane Artifacts," Bruno Latour claims that when it comes to understanding complex sociotechnical systems and conditions, both social constructivism and technological determinism are flawed and overly simplistic. Both explain things in terms of cause and effect but social constructivism claims that all media, systems and structures are the result of the human, social, cultural and political forces in effect at any given place and time. Technological determinism says the reverse is true: technology, media and science determine human, social and cultural organization. Actor-network theory (ANT), by contrast, maintains that all systems are networks comprised of both human and non-human actors, all of which can perform functions and have the power to alter the system as a whole. Traditionally, agency is only ascribed to human beings. In ANT, however, it is also ascribed to technologies, tools, parts and other non-human actors because of their power to alter the behaviour of systems. Describing both the sociologism implicit in social constructivism and the technologism implicit in technological determinism as absurdities, Latour writes:

From now on, these two absurdities will, I hope, disappear from the scene, because the actors at any point may be human or nonhuman, and the displacement (or translation, or transcription) makes impossible the easy reading

out of one repertoire and into the next. The bizarre idea that society might be made up of human relations is a mirror image of the other no less bizarre idea that techniques might be made up of nonhuman relations. ... Do you want to cut through this rich diversity of delegates and artificially create two heaps of refuse, 'society' on one side and 'technology' on the other? That is your privilege, but I have a less bungled task in mind. (162)

According to ANT, it is not possible to describe society without including the role that technology plays and, equally, it is not possible to describe technology without also discussing the role society plays. They are not mutually exclusive domains.

The term 'network' in ANT needs to be understood fairly loosely, broadly applying to a range of scale of systems from large to small. Thus, a car is conceived as a discrete thing as long as it is working smoothly, but as soon as it starts to break down, it is understood as a network of integrated systems that might individually need to be fixed (drive, fuel, suspension, transmission, electronics, etc.). Each of those systems, furthermore, consists of a combination of smaller and smaller sub-systems, the closer you look. By extension, a car also needs a driver and, arguably, an attendant at the gas station, the assembly line worker who built it, etc. Thus, it is impossible to discuss the car without discussing it in both technical and human terms.

Within any given system, the human and technical agents are interchangeable. In other words, just about any given function in a system can be accomplished by either a human or non-human actor. Latour explains this fact using an example of a wall with a door and a door closer. In order to get through the wall, one could break a hole in it every time you needed to pass through, but then someone else would have to repair the hole again each time. Alternatively, it is possible (and simpler) to install a door but that requires that the person who opens it also has to close it again each time or else it would be useless. Another possibility, then, would be to install a mechanical door closer to

close the door automatically; but it is equally possible to hire a doorman to do the job instead (Latour 153-9). In other words, in all three cases, the role of closing the door could be ‘delegated’ to either humans or things (Latour 155, 157). Since in any given circumstance, each option would have its advantages and disadvantages, there is no one right answer. The technological solution is not always an improvement on the human; the high-tech not always better than the low-tech.

Engineers, technologists and designers constantly swap out human and non-human actors and roles by breaking down and redistributing, or delegating, functions and competencies between the two (Latour 169). Ironically, however, these disciplines are typically understood as belonging purely at the technology end of the technology/sociology spectrum. This, according to Latour, is the paradox of technology: “it is thought to be at one of the extremes, whereas it is the ability of the engineer to travel easily along the whole gradient and substitute one type of delegation for another that is inherent to the job” (Latour 166). It is important to note that this travel can go in both directions. It is not a one-way street that only travels in the direction of increasingly automated progress.

Though Latour doesn’t explicitly address the mobile phone in India, ANT is useful to understand why the mobile landscape there is so different there than here in Canada. According to ANT, both conditions are equally valid solutions to a given set of circumstances; context, therefore, matters. In India, low wage levels, poorly enforced regulations, a well-established informal economy and high-density living conditions result in one mobile phone landscape. In Canada, high wage levels, relatively limited choice and competition between manufacturers and service providers and historically

more reliable electricity and Internet service have resulted in a different Internet and mobile phone landscape.

I applied a number of ANT concepts in my projects. *textDIAL*, for example, uses Indian call-centre agents to perform certain smartphone functions and *stereoPHONEic*, substitutes rotary dial phone hardware for a smartphone. My overall approach to the problem of accelerated obsolescence, furthermore, is to work with what we already have and re-use it in new contexts rather than to create new things that make even more old things obsolete. In this sense, I believe that the ideas that I have highlighted in this section dovetail nicely with those in the Obsolescence section.

Conclusion

As a result of my literature review, I could better contextualize my experiences in India and I gained a better understanding of the Indian mobile phone economy. I also gained a new perspective on ubiquitous computing compared to what I had first encountered in the writings of Weiser and Greenfield. I came to understand UbiComp as something that exists today, not in the proximate future, and that arrived in the form of the mobile phone. I also gained an understanding of the usefulness of seams, mess and flaws in computer systems, which I subsequently designed into my research projects. From Acland, I gained the concept of persistent media, which I embodied in my design research projects. Lastly, actor-network-theory helped me understand that in complex sociotechnical networks it is possible to delegate functions to both human and non-human agents, something that I subsequently applied in my *textDIAL* project.

Chapter 4

Art & Design Context

Chapter Four - Art and Design Context

In addition to reviewing literature to support the development of my thesis, I also surveyed art, design and performance work that was relevant, either thematically or methodologically. This chapter outlines a selection of these pieces and describes how they influenced my own design research process. The chapter is organized thematically and refers to the following works in the order that I encountered them: *Call Cutta in a Box* by Rimini Protokoll, *Ghana Think Tank*, by Ghana Think Tank, *Homeless Vehicle* by Krzysztof Wodiczko, *Placebo* by Anthony Dunne and Fiona Raby and *Feral Robotic Dogs* by Natalie Jeremijenko, all of which are described and illustrated in Appendix B.

The inverted metaphor

Although, strictly speaking, a grammatical term, I first heard the phrase ‘inverted metaphor’ used metaphorically; as an art and design device by Newton and Helen Mayer Harrison to describe their own eco-art work. I use the expression the same way in this paper. *Ghana Think Tank* is a series of projects that play on the metaphor of the think tank. Originally held in Ghana, from where it was named, *Ghana Think Tanks* have since been organized in a variety of locations around the world, always pairing two communities, one from the ‘developed’ world, such as Liverpool or Berlin and one from the ‘developing’ world such as Oaxaca, Mexico or Ethiopia. The institution of the think tank, as we know it, is typically a first-world phenomenon associated with expert opinion, power to influence change and, sometimes, hidden agendas. *Ghana Think Tank*, by contrast, turns that metaphor on its head by asking developing world participants to solve local the first world participants’ problems. In the process, it brings two distant communities in contact with each other and positions the developing world participants

as experts supplying solutions to first world problems rather than the other way around. Early on in my research, I applied the inverted metaphor device as an ideation method and it led directly to *Upcycling #1 – The Really Smart Phone*, which plays on the metaphor of the Indian call centre, but inverts it, positioning the network of call-centre smartphone service providers as genuinely helpful people you would actually want to call if you wanted smartphone services but didn't own a smartphone.

The Really Smart Phone, in turn, led me to Rimini Protokoll's *Call Cutta in a Box*, a two-person performance piece played out between one call-centre employee in Kolkata and one caller in a northern European city. Rather than buying a ticket, the European participant books an appointment and arrives at a generic-looking office, at which point she or he receives a call from Kolkata, and so the performance begins. The call-centre employee works from a script but also has room to ad-lib. At first, he or she establishes the distance between the two participants' locations but gradually and deliberately, collapses both the space and time zone differences. By the end, the two are singing and dancing together and have experienced a genuine kind of intimacy. *Call Cutta in a Box* also plays on people's expectations of Indian call-centre workers, foreign cultures, geographical distance, alienation associated with outsourcing and the medium of theatre. Both *Ghana Think Tank* and *Call Cutta in a Box* employ familiar metaphors in unfamiliar ways and bring previously distant people and places closer together to surprising effect. Both, furthermore, create unexpected experiences for local participants.

Performance and participation

Ghana Think Tank and *Call Cutta in a Box* employ an open-ended structure rather than predetermined scripts and rely on non-professional actors and the lay-public to

perform roles and contribute much of the content. As a result, each *Ghana Think Tank* project produces a different set of problems and solutions. The call-centre agents' performances in the *Call Cutta in a Box* compilation video (www.rimini-protokoll.de/website/en/project_2766.html) are scripted to a certain extent but leave room for improvisation; the European participant is entirely unscripted. As a result, no two performances are the same. Krzysztof Wodiczko's *Homeless Vehicle* is also intended to be operated by lay people, in this case the homeless, amid the hustle and bustle of New York City's streets. Highly conspicuous and designed for the conditions of homelessness (a continual state of mobility, scavenging to make money and the need for shelter), *Homeless Vehicle* attracts attention to the needs of a group of people that can often be invisible. These projects helped me understand the power of performance in public spaces and suggested how I could use performance in my own projects, especially *stereoPHONEic*.

Critical design and provocation

I also reviewed a number of works of critical design, including *Placebo*, by Anthony Dunne and Fiona Raby and *Feral Robotic Dogs* by Natalie Jeremijenko. The *Placebo* project consists of eight furniture pieces with fictitious functions, such as *The Electricity Drain* table, which were individually placed in people's houses in order to investigate their occupants' attitudes towards electromagnetic fields in the home. The *Placebo* pieces are highly stylized to suggest that they were very carefully designed, but not actually designed for comfort or real functionality. As Anthony Dunne and Fiona Raby wrote, "It is unlikely that any of the *Placebo* prototypes will make it into 'reality', at least not through the commercial marketplace. As one-offs, these products would be

prohibitively expensive” (Dunne and Raby 75). Rather than being commercially viable consumer products, the *Placebo* pieces were designed to provoke reactions in their users, ask questions and raise awareness about something that surrounds us all invisibly. If the tables and chairs were more comfortable, then the users would be more likely to overlook them as they went about their day. It is their apparent dysfunction and discomfort, therefore, that makes them function critically, if not commercially; that makes them critically useful if not commercially so. The object of design, then, does not always have to be solutions to given problems. Dunne and Raby wrote that “Designers cannot always solve problems, we cannot switch off the vast electromagnetic networks surrounding us all. Although we cannot change reality, we can change people’s perception of it” (Dunne and Raby 75).

Jeremijenko’s *Feral Robotic Dogs* are hacked and repurposed off-the-shelf toy robot dogs that can detect (sniff out) radioactivity levels that exceed acceptable EPA standards in soil and then walk toward the location of highest concentrations (Freyer, Conny and Sebastien 228). *Feral Robotic Dogs* uses humour, irony, surprise and play to toy with people’s expectations and raise awareness about the problem of environmental pollution. *Homeless Vehicle*, similarly, uses a high-polished bullet aesthetic to make the invisible (the homeless) highly visible and ask questions about the real needs of the homeless. *Homeless Vehicle* is designed to empower a marginalized group; *Feral Robotic Dogs* is designed for grassroots level empowerment. Both are designed to identify problems rather than come up with solutions.

As a result of studying Wodiczko, Dunne and Raby and Jeremijenko, I came to understand critical design as a method that used designed objects and constructed scenarios to raise questions about things that are invisible or taken for granted; to

critique the status quo; and to identify problems rather than solutions. Traditionally, the value of a designed object is measured in terms of such things as usefulness, functionality, affordability and beauty. The critical design object, by contrast, has to deliberately undermine those measures in order to function on a different, critical level. There are many ways of doing this including the disrupting assumptions, refusing to comply with aesthetic norms and the use of irony, humour, provocation, deliberate dysfunction, absurdity and ambiguity. Additionally, all the projects in this chapter move out of the gallery, off the stage and into everyday public places in order to come into contact with local participants and the public realm. For me, embracing critical design became a turning point in my own design research. It gave me permission to redefine the ‘usefulness’ of the phones I was designing; to use them to ask a range of questions from obsolescence to interface design; and to blur the lines between traditional art and design practices.

Common themes

A number of the projects above also resonate thematically with my research topic. *Ghana Think Tank* and *Call Cutta in a Box*, for example, involve communication networks, connect people and places that are thousands of kilometers apart and bridge the so-called north-south divide. *Feral Robotic Dogs* involves sustainability, hacking and repurposing technologies. *Homeless Vehicle* involves questions of appropriate technology and workarounds by the poor and homeless and *Placebo* involves people’s relationship to electronic technologies. They also resonate with themes identified in the literature review. For example, what Dourish, Bell and Chalmers said about the importance and the beauty of messiness, seams and faults parallels with the way that the critical design

pieces were deliberately dysfunctional, uncomfortable and commercially non-viable. Just as Chalmers argued that it was the seams and faults that give us entry points into computer networks, it is the faults, awkward juxtapositions and flaws that give critical design pieces an added layer of meaning. Lastly, Nimmi Rangaswamy described grassroots level, bottom-up processes of entrepreneurship and, along with Dourish and Bell, described ubiquitous computing that was grounded in place and local cultural practice. I see these sensibilities reflected in *Ghana Think Tank*, *Call Cutta in a Box*, the *Homeless Vehicle*, and *Feral Robotic Dogs*, each of which was firmly grounded in local citizen participation and particular places.

Chapter 5

Design Research

Chapter Five – Design Research

To reiterate, my core research questions are: is there an alternative to the ever-shrinking obsolescence cycle of the mobile phone; what constitutes the mobile phone and just how far can we push the definition of it; and what are the implications for technology innovation? In addition to approaching these questions from a theoretical standpoint (the literature review) and a survey of related artists and designers, I also approached it using hands-on learning, critical design, prototyping, iteration and performance. This chapter will describe those methods and processes as well as the project outcomes.

Hands-on learning

With little or no background in electronics or app development, other than a basic Processing and Arduino course, my first task was to explore a number of technologies and platforms to learn how they worked and whether they could be useful in my efforts to repurpose old phones. To start with, I took apart a number of Motorola, Nokia and Sony Ericsson text-based ‘dumb’ phones and did research online about what could usefully be harvested from them. I was hoping to be able to re-use some parts or sensors and put them to new purposes. However, I learned that mobile phone hardware is designed for miniaturization and not for adaptation. The function of their various chips and electronic parts is not very apparent, chips and sensors are not engineered to be re-usable once they have been removed from their original assembly and connections are not made to be taken apart and reconnected. Rotary dial phones turned out to be a very different story once I opened them up.

My next task was to learn how a rotary dial phone worked. For example, how exactly does the dial dial a number? It turns out that a rotary dial is really just an elaborate contact switch that opens and closes a number of times corresponding to the number dialed: once if you dial one, four times if you dial four, etc. In other words, behind the seemingly analog dial was a digital switch, which made it relatively easy to incorporate the dial into other digital platforms, such as Arduino and Processing. Figure 3 shows a Processing sketch that prints the number dialed onto the computer screen using an Arduino board as the go-between.

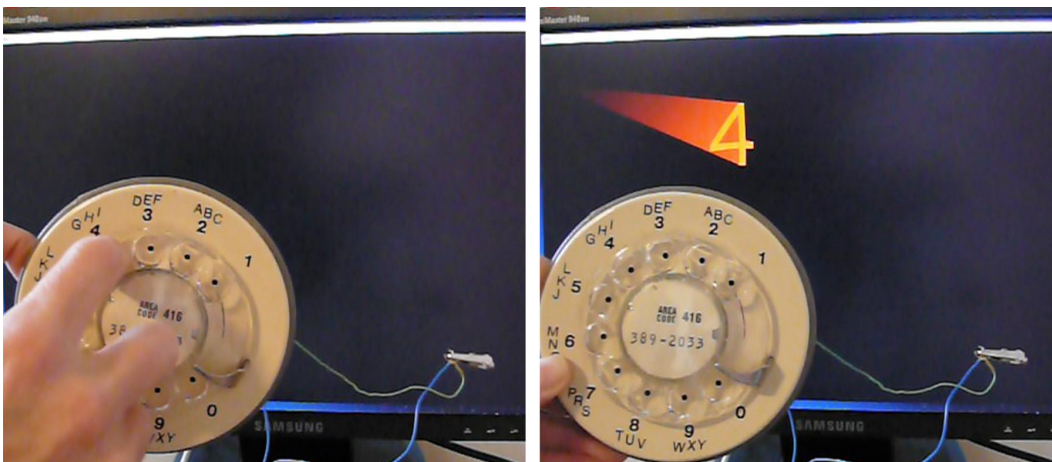


Figure 3: Dial a number and it appears on the computer monitor. Combines phone dial, Arduino and Processing.

The next question that I addressed was what made the phone's bells ring and how could the ringing interface with Arduino? The result was a small project called *CacoPHONEy*, which consisted of a pair of phones whose ring speed could be controlled by a potentiometer built into one end of each phone's handset. Meant more as a noisemaker and a way to experience the genuine ring of an old phone (as opposed to the synthetic ring of a custom ringtone), *CacoPHONEy* let two people 'talk' back and forth

with each other using variable rings, or no ring at all, or simply play with the noise. In the end, I had to figure out a number of rotary dial phone functions, including what type of current (AC or DC) a phone used and for what function, how the microphone and speakers in the handset were wired and how to connect to the hook switch.

I took a number of important things away from the hands-on learning process described above, besides the obvious technical know-how: for example, a keen awareness of the affordances of the telephone; an appreciation of how telephones are designed to last (robust wiring and spade and screw terminals that make it easy to take things apart and put them back together); and a strategy of blending or combining analog and digital technologies — all things that were carried forward into subsequent projects.

Conceptual and critical design

At the same time as conducting the hands-on work, I also explored the topics of mobile phone networks and how to give dumb phones smartphone functions through a series of conceptual ideation exercises. These borrowed on the themes and methods from the literature review and the art and design review and gradually built on what I gained in my hands-on work.

The first design concept, *Upcycling #1: The REALLY Smart Phone* was the result of applying the inverted metaphor device used in *Ghana Think Tank* to the question of how to give dumb phones smartphone functionality. See Figure 4. William McDonough and Michael Braungart coined the terms upcycling and downcycling in their book *Cradle to Cradle: Remaking the Way We Make Things* to explain that, when it comes to environmental sustainability, not all recycling is created equal. Recycling that

downgrades high-grade, highly specialized or high embodied-energy products and materials (e.g. solid douglas fir beams, medical devices or aluminum windows) to low-grade materials (e.g. acoustic panel material or wood chips for landscape mulch) is called downcycling. By contrast, recycling that re-uses materials and equipment in ways that are equivalent or better than their original state (e.g. recycling the beams from one building as beams in another) is called upcycling (McDonough and Braungar 110). Clearly, from an environmental sustainability standpoint, upcycling is more valuable than downcycling.

Upcycling #1: The REALLY Smart Phone describes a network of human smartphone service providers that people with dumb phones could subscribe to in order to upgrade the functionality of their old dumb phones without having to throw them out. Different smartphone service providers would provide different common smartphone services, such as telling the time, providing wake-up calls, giving directions, storing information, doing calculations and even playing games. *The REALLY Smart Phone* borrows from Nimmi Rangaswamy's observations about the high-density niche-service structure of the Indian informal phone economy, which lowers the entry bar into the marketplace for individual micro-entrepreneurs and simultaneously adds up to a full-service environment for the consumer because services are multiplied hundreds and thousands of times over in the high-density conditions of Indian cities. A similar structure is in play in *The REALLY Smart Phone* because individual service providers with as little as a calculator or a slide rule could become micro-enterprise smartphone function service-providers but, multiplied hundreds and thousands of times over, they would add up to a full-service smartphone. Furthermore, since the smartphone service providers could be distributed in developing countries across different time zones, 24/7

access could be guaranteed for the customer.

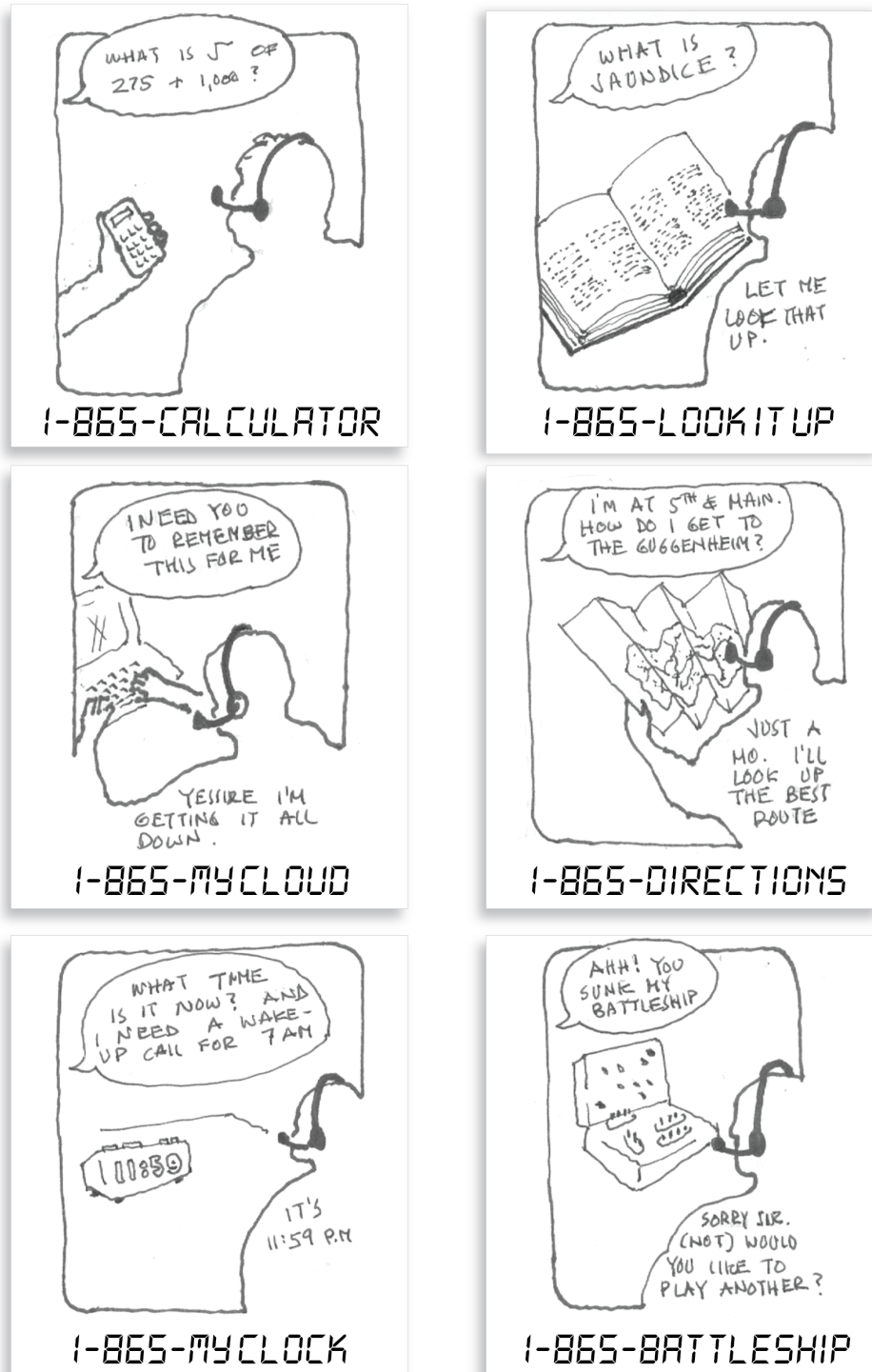


Figure 4: *Upcycling #1: The REALLY Smart Phone*

According to actor-network-theory, technological systems are understood as systems of both technological and human actors and most tasks and functions can be delegated to, or performed by, either. *The REALLY Smart Phone* is an example of how certain smartphone functions can be performed, equally, by a technological device or a human being. For most of us, calls from strangers in call-centres in distant countries are a nuisance. *The REALLY Smart Phone* inverts that relationship and makes the stranger your friend, something that it has in common with Rimini Protokoll's *Call Cutta in a Box*. By offering the possibility of human contact and a relationship with someone in an unfamiliar context, it helps re-humanize outsourcing associated with call-centre services. These are things that a conventional smartphone just can't do.

Unlike *Upcycling #1*, which was an ideation exercise, *Upcycling #2: Heavy-Duty Mobile Phone* was originally conceived as a design to be prototyped and built. A different variation on the upcycling concept, it was a proposition for bringing smartphone functionality to rotary dial phones. In a nutshell it consisted of four rotary dial phones carried on a heavy-duty book truck. The ten finger stops on a single phone are adequate to dial a phone number but if you want to text (and what's a mobile phone if it can't text?) and do additional smartphone functions, then more devices are required. For this reason, *Upcycling #2* uses four phones to provide for twenty-six letters plus ten numerals plus a few additional options for punctuation, send and backspace on the dial. Being too heavy to carry around easily, the four phones are placed on a book truck for the sake of mobility. A book truck was chosen for its heavy-duty construction and because, in the age of digital media, book trucks were potentially another source of obsolete equipment also in need of upcycling. With no visual display affordance, incoming texts have to be listened to, not read, on one of the phones via a text-to-speech service, such as Twilio's

web services (www.twilio.com). The audio on the remaining phones could be used to listen to music and hear the time, two additional important smartphone functions. See Figure 5.

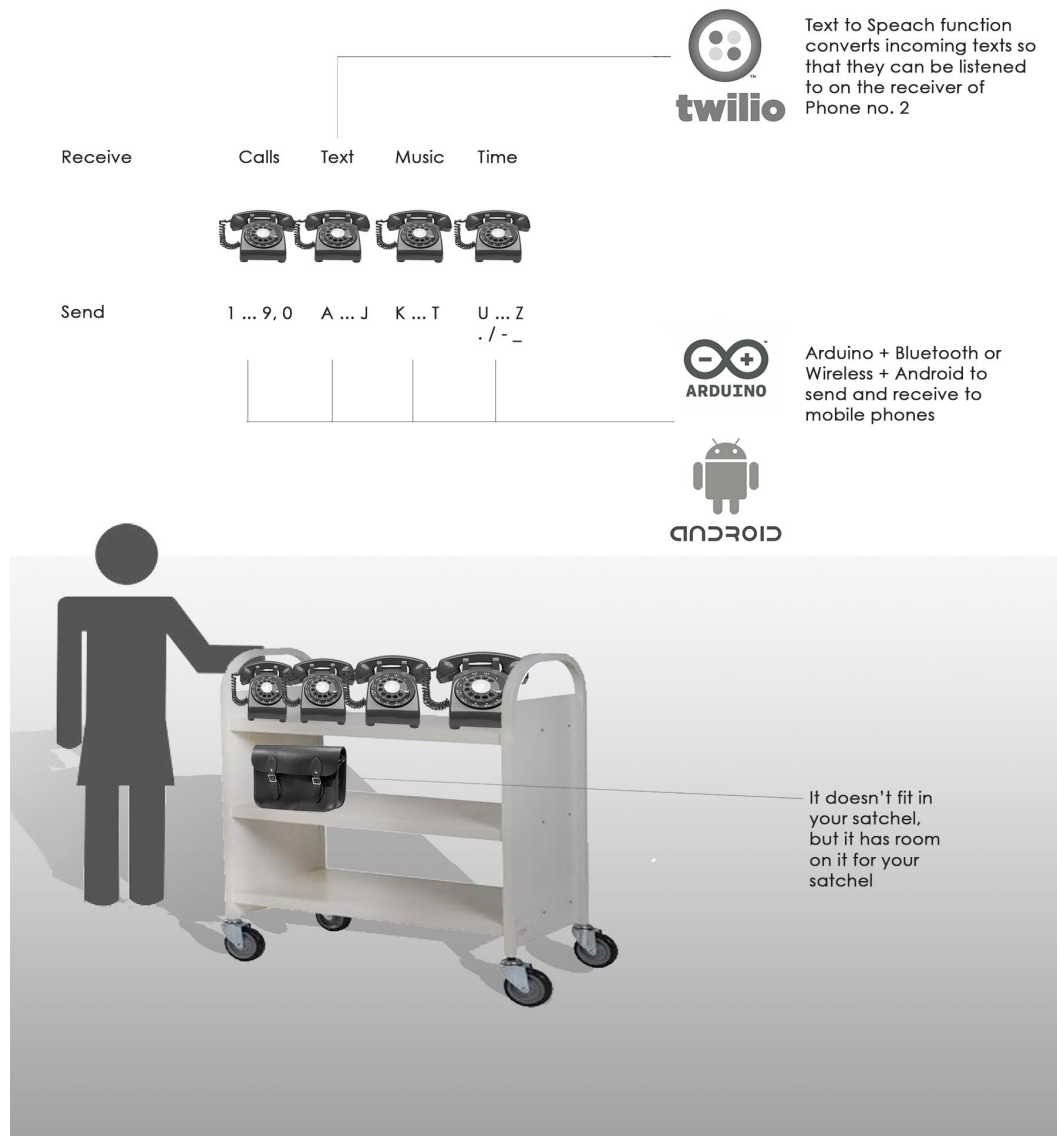


Figure 5: *Upcycling #2: Heavy-Duty Mobile Phone*

This project represented an important turning point in my design process. It was at this stage that I had begun to look more closely at the critical design work of Natalie Jeremijenko and Dunne and Raby, and started to develop an understanding of

critical design practice. As a result, I also started to recognize the critical, provocative and performance dimensions of my own design proposals and give myself permission to push the envelope in that direction much more than I had up to then. In other words, I gave myself permission to not think in terms of design for widespread distribution in the commercial marketplace and to not have to be so sensible. For example, I began to imagine what it would be like to haul a book truck of phones onto a streetcar and then send texts, listen to music and do other things that transit-riders typically do on their smartphones to wile away the time — only I would be doing them on very conspicuous, and possibly quite loud, rotary dial phones. At this stage, the performance potential in my design was also beginning to emerge.

Prototyping

In order to make the prototyping required by *Heavy Duty Mobile Phone* more manageable, I decided to break the project down into a number of smaller, standalone projects and tackle one at a time. The first of these, the music-playing module, became *stereoPHONEic*, a wearable phone modified to play music, in stereo. See Figures 6 to 11 for images and Appendix C for the code.

stereoPHONEic consists of a single rotary dial phone that can be worn on your belt (thus making it a mobile phone). Shoulder brackets attached to the handset permit it to be worn on the shoulders and conveniently position the mouth- and earpieces behind each ear. Inside the body of the phone, the rotary dial is attached to an Arduino board, this time fitted with an MP3 shield and a micro-SD cardholder. Inside the handset mouthpiece, the original microphone was replaced with a speaker salvaged from a second phone so that there would be one speaker in each end of the handset, wired to

the Arduino via the phone's original curly cord wiring and terminal block, and delivering stereo sound. The ten positions on the rotary dial are used to select tracks one through six, control the volume and pause, resume or stop the music.

The earliest prototype was a physical model that didn't actually play music. It used bent wire coat hangers for the shoulder brackets, carabiners for belt loops, and marker on masking tape to suggest what each dial-stop did. The next prototype was functional and consisted of an Arduino board with an MP3 shield and a micro-SD card-holder, a breadboard for the necessary resistors and wiring and ear-buds in lieu of the phone's speakers. There were a number of challenges at this stage, including learning the SFEMP3Shield library code, which I tackled by starting small and simple and gradually scaling up in size and complexity. I also worked through a number of different dial-control layouts and struggled with the ridiculously delicate ear-bud wiring. For the third stage prototype, I soldered a new audio jack with decent-gauge wiring, abandoned the ear-buds and wired everything right into the phone's original curly cord and terminal block. The handset mouthpiece was modified inside to receive a speaker and the earpiece cap was drilled so that its hole-pattern matched the mouthpiece. At this point, *stereoPHONEic* was fully functional but there was still room for improvement to its form factor. Additional improvements included laser-cutting new dial numbers and symbols, replacing the coat-hanger shoulder brackets with acrylic ones, improving the belt-loops and adding an external battery-connection so that the phone cover didn't have to be removed to connect or recharge the battery. It is worth noting, that the process was not as smooth or linear as the above description makes it sound and it can be surprising how many iterations are required to get even relatively straightforward things right. The belt loops, for example, took four.



Figure 6: How to use *stereoPHONEic*. Step one: carry it conveniently on your belt when not in use; step two: when ready to listen, place handset on your shoulders; step three: use dial to chose track, control volume, pause and resume; step four: enjoy.

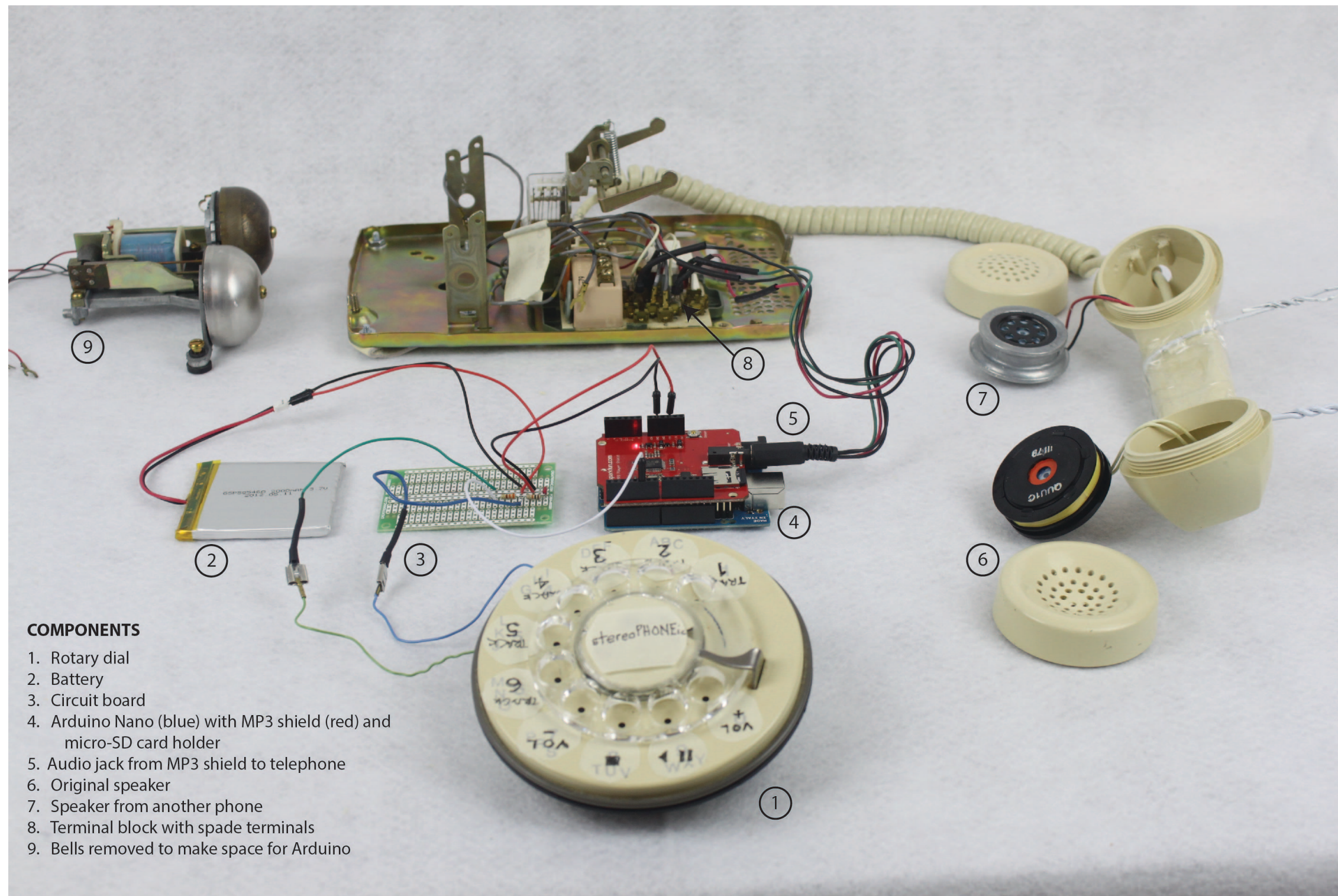


Figure 7: *stereoPHONEic* components

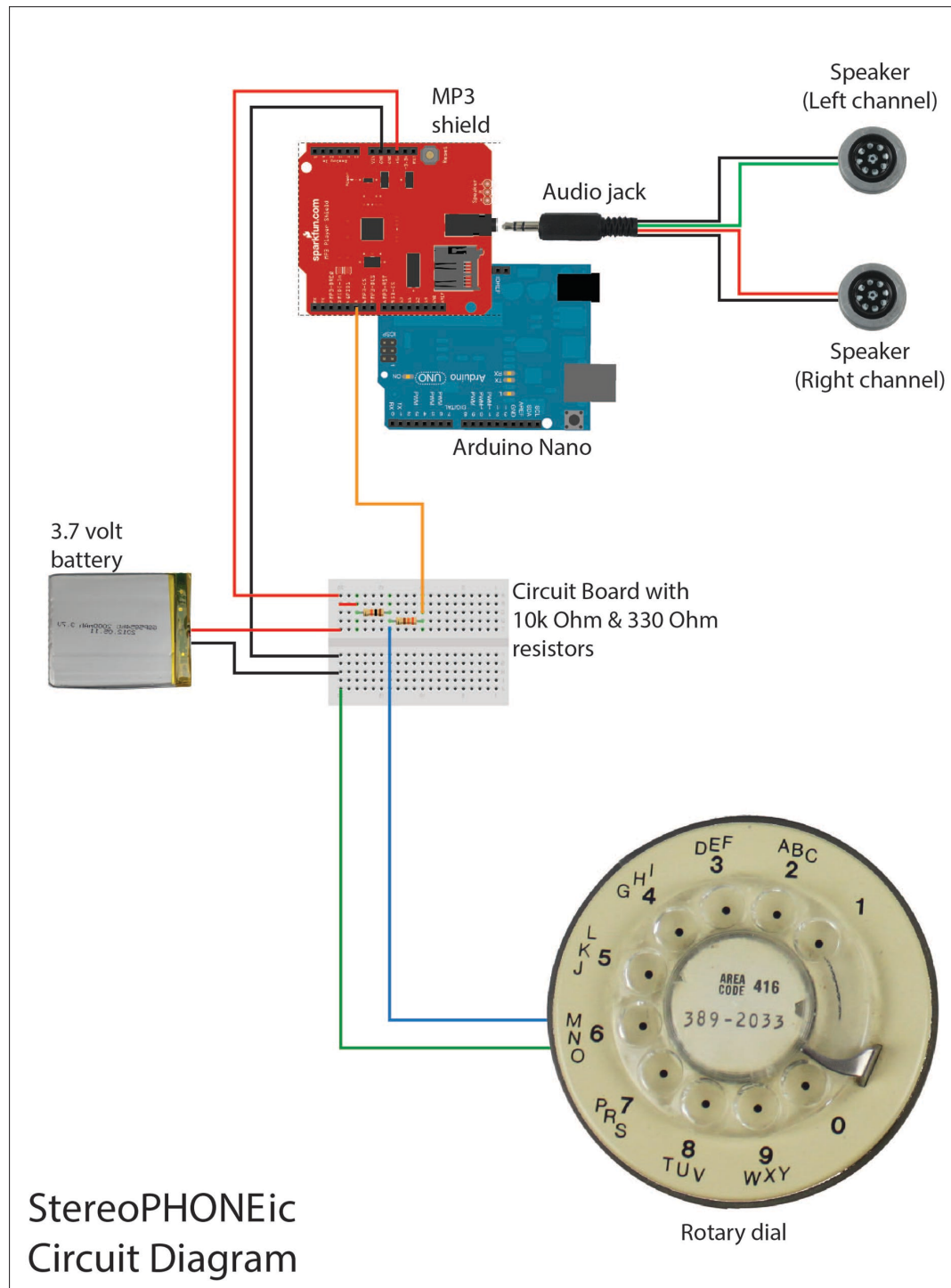


Figure 8: *stereoPHONEic* schematics



Figure 9: Iterative development of the *stereoPHONEic* dial, from diagrams to masking tape to laser-cut plastic



Figure 10: Patterns and prototypes for the final acrylic shoulder brackets



Figure 11: *stereoPHONEic* exhibition

The next module from *Heavy Duty Mobile Phone* for prototyping was the texting function. Like *Heavy Duty Mobile Phone*, it consists of four dial phones to support numerals, letters, a limited range of punctuation, Backspace and Send in a straightforward manner. To send a text using *textDIAL*, the user would pick up the handset and hold it to their ear. This would raise the hook switch, turn the system on

and read a set of instructions for how to send and receive texts. The user would then compose their message by dialing one letter or numeral at a time and dialing Send when ready. In order to provide at least a certain degree of feedback, each time a person dials a letter, number or punctuation mark, he or she will hear it read back to them through the handset earpiece. When Send is dialed, the person would hear “Your message has been sent.” With no visual display, I anticipate that the process will be slow, cumbersome and somewhat disorienting. The practice of texting on mobile phones has already resulted in a casual kind of shorthand and I am interested to see if the limits of the dial interface would force that process even further. To receive a text, the phone would ring, indicating that a message is incoming and prompting the user to pick up the receiver. Once again, with no visual display, texts have to be received by ear. To accomplish this, an Indian call-centre agent would read the incoming text to the listener and, thereafter, be available for conversation, if desired – truly an added-value service compared to the existing mobile phone text experience.



Figure 12: The *textDIAL* paper prototype

Figures 12 and 13 show *textDIAL* in the paper prototyping stage. Paper-prototyping revealed the need for instructions for the first-time user because there was room for confusion, particularly with the Send and punctuation functions. The next prototyping stage was a partially functional model that could send outgoing messages to a text file and provide audio instructions. This is the model that was exhibited at the thesis exhibition. Technically, these functions used some of the same features as *stereoPHONEic* (Arduino, MP3 shield, SFEMP3Shield library code, phone dial and

phone speaker) and some new ones (phone's hook switch, writing to a text file, displaying to a Processing sketch). Future prototyping stages will include making *textDIAL* communicate wirelessly with other cell phones and adding a human being to read the incoming texts. Initially, that person could be myself or someone else local, but once things are working, it could be Indian call-centre agents.



Figure 13: *textDIAL* paper prototyping in progress

The *textDIAL* model displayed at the exhibition was an interactive prototype of the phone interface for sending outgoing messages that allowed members of the public to try out the phones and compose messages. Then when they dialed Send, their message would be projected onto the wall, followed by an instruction for someone to dial a reply. In the background, the messages were collected in a text file. In order to

minimize visual feedback, messages were not displayed until Send was dialed. See Figures 14 to 17.



Figure 14: *textDIAL*: four phones on a cart, for mobility



Figure 15: *textDIAL*'s fourth phone provides letters, Period, Space, Delete and Send

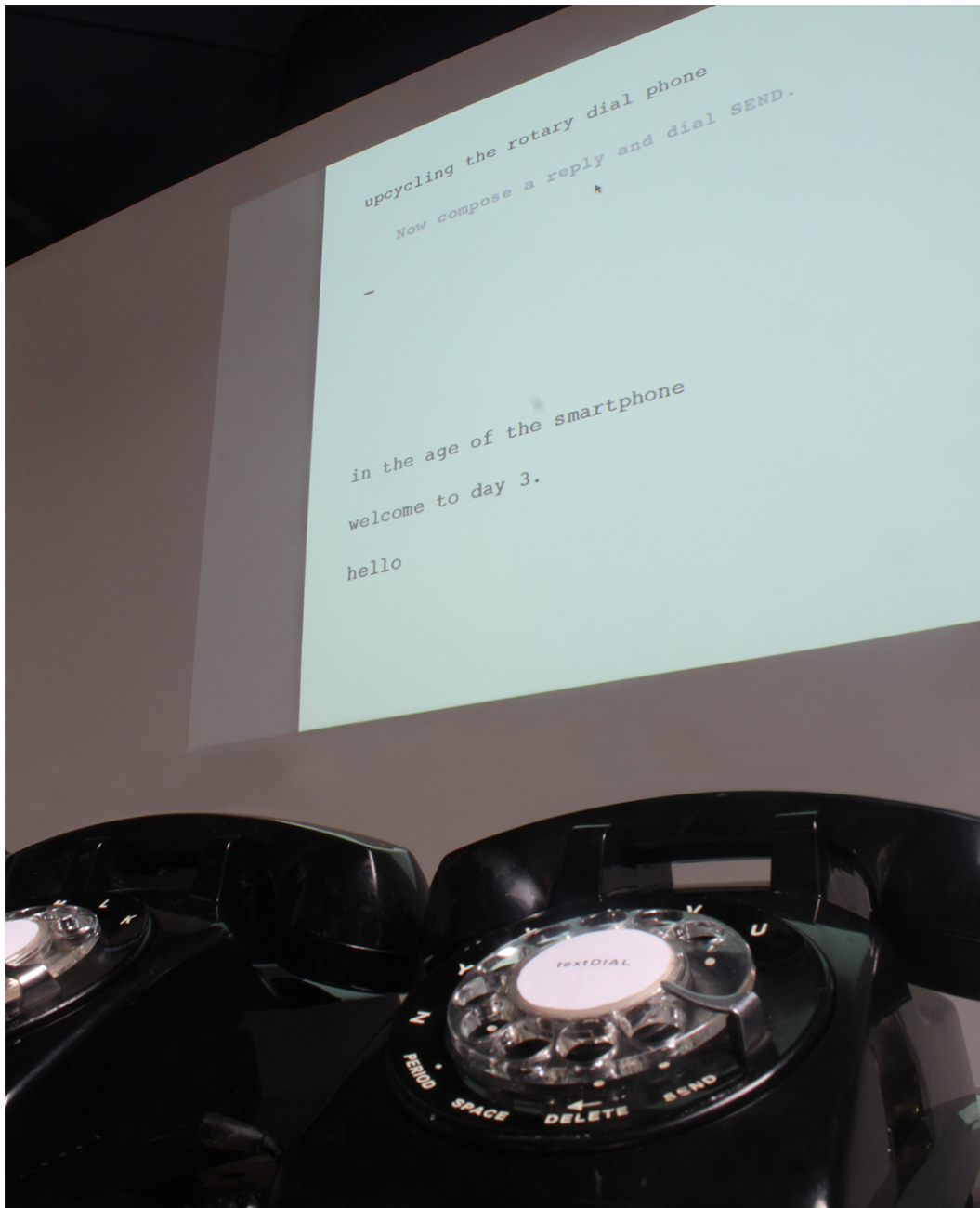


Figure 16: *textDIAL* message display at the exhibition



COMPONENTS

- | | |
|---|---|
| 1. Circuit board for Arduino Nano | 6. Red phone for listening to instructions and dialing numerals |
| 2. Arduino Nano with MP3 shield for instructions on red phone | 7. Black phone for dialing A to J |
| 3. Battery | 8. Black phone for dialing K to T |
| 4. Arduino Mega ADK connected to phone dials | 9. Black phone for dialing U to Z, Period, Space, Delete and Send |
| 5. Circuit board for Arduino Mega ADK | 10. Cart to make it mobile |

Figure 17: *textDIAL* components

As a mobile phone *textDIAL* is designed to be deliberately non-viable (in a business sense), unwieldy (being too cumbersome to be portable and having no visual display) and awkward, in order to stretch the definition of the mobile phone and make people think twice about ontological and user-experience issues. With respect to the latter, I have learned in the process of designing, prototyping and using *stereoPHONEic* and *textDIAL*, that the limited affordances of the rotary dial phones force issues of interface design, user-experience and feedback to the foreground because of the lack of conveniences, such as touchscreen controls and graphic displays, that we have come to expect from our smartphones.

Performance

Both *stereoPHONEic* and *textDIAL* have important performance aspects.

stereoPHONEic is intended to be worn in public spaces in order to experience what it is like to wear in an everyday context and also to encounter the everyday reality of today's smartphones (Samsung Galaxy S4 and iPhone ads, mobile phone stores, waiting at the streetcar stop, grocery shopping, etc.). See Figures 18, 19 and 20.



Figure 18: Getting on the Bathurst streetcar, wearing *stereoPHONEic*



Figure 19: Leaning against an iPad ad at the streetcar stop



Figure 20: Pausing *stereoPHONEic* to order a donut

Conclusion

This chapter described my design research methods and projects to date. Projects and experiments included *cacoPHONEy*, the two *Upcycling* projects entitled *The REALLY Smart Phone* and *Heavy Duty Mobile Phone*, *stereoPHONEic* and *textDLAL*. Methods included hands-on learning, conceptual and critical design, prototyping, iteration and performance. The projects addressed my research questions by proposing a number of ways to re-use old phones, all of which would be alternatives to the ever-shrinking obsolescence cycle of the mobile phone. They also asked questions regarding the nature of the mobile phone by proposing models that are a far cry from today's smartphones. The question regarding the implications for technological innovation is more general, by nature, and will be addressed in the following Reflection chapter. *stereoPHONEic* and *textDLAL* also incorporate themes and methods identified in the literature review and art and design context chapters, including delegating smartphone functions to other actors (both human and technological), the persistence of the rotary dial telephone, blended, seamful and messy technologies, critical design, provocation and performance.

Chapter 6

Reflection

Chapter Six – Reflection

My original research questions related to increasingly short mobile phone obsolescence cycles, the definition of the mobile phone and innovation in the digital technology space. This chapter will consider the *The Really Smart Phone*, *Heavy Duty Mobile Phone*, *stereoPHONEic* and *textDLAL* projects in light of those questions, incorporating the themes and methods highlighted in the literature review and the art and design context chapters.

With respect to the question of just what constitutes a mobile phone and how far can we push the definition, each of the four projects mentioned above tries to answer that question in a slightly different way, always begging the question: am I a mobile phone? Thinking simply in terms of hardware, none could really be considered a mobile phone, let alone a smartphone, at least not as we have come to know them. Looking beyond the hardware, however, things are not so clear-cut because a mobile phone is more than hardware and software. It is also the people involved, the things that a mobile phone lets us do and what becomes habituated into our lives. Thinking purely in these terms, my projects could be considered as mobile phones because they offer a number of smartphone services. *stereoPHONEic* and *textDLAL* literally play music and send and receive text messages. *The Really Smart Phone* and *The Heavy Duty Mobile Phone*, more hypothetically, offer a range of other smartphone functions, such as playing games, telling time, helping with navigation and storing data. A mobile phone, of course, is also mobile. In this sense, too, my projects are also mobile and portable. On the other hand, *The Really Smart Phone*, and *textDLAL* use humans to perform certain key smartphone tasks, and that doesn't sound like technology. However, ANT tells us that all systems

have both human and non-human components and that functions can be delegated to either. If this is the case, then the fact that some of my phone projects use human beings shouldn't prevent them from being described as mobile phones. And the fact that some of those humans could be situated ten thousand kilometers away in an Indian call-centre also shouldn't change the fact. In fact, it only serves to reinforce the conclusion that the definition of the mobile phone, must be expanded well beyond the device you hold in your hand or see in the advertisement.

If you accept that my phone projects are, in fact, mobile phones, then you can begin to ask other questions about what defines the mobile phone. For example, does a mobile phone have to be electronic and digital or can it be a combination of the electronic, mechanical, digital and analog, as my phones are? Are mobile phones and rotary dial phones completely incompatible species or can their technologies be blended together, as they are in my phones? For that matter, can they be blended with humans? Lastly, if you can accept that my phones are mobile phones, then you can begin to answer another of my original research questions: just how long can the life of the mobile phone be extended? In the case of *stereoPHONEic* and *textDLAL*, the answer is at least forty-three years based on the phones' 1970 dates of manufacture.

In another sense, of course *The Really Smart Phone, Heavy Duty Mobile Phone*, *stereoPHONEic* and *textDLAL* are not really mobile phones or smartphones. They are too heavy, bulky and expensive to be commercially feasible; they aren't very practical and they aren't even serious solutions to the problem of reducing electronic waste. In fact, they could be described as not very serious or useful solutions or even absurd propositions. Critical design, however, shows us that design does not have to be restricted to finding better solutions to given problems and usefulness does not have to

be measured in the commercial marketplace. Design can also be about identifying problems, bringing awareness to issues or to things we take for granted, or adding new layers of meaning to the objects around us. These too, are useful.

What, then, distinguishes a critically-useful project from a commercially-useful one? My projects are very seamful and messy, blending and juxtaposing disparate technologies (mechanical, electronic, digital, analog, human), forty-year-old phones with contemporary electronics and people in both the developed and developing worlds. In this sense, they parallel Nimmi Rangaswamy's description of the unstable and discontinuous infrastructure, dated and sometimes-dysfunctional ICT hardware, mixed levels of literacy and numeracy and spirit of *Jugaad* that characterizes the mobile phone landscape in Indian slum neighbourhoods. The phones are also awkward and dysfunctional, being bulky and offering limited functionality. Furthermore, in the context of smartphone design, they are paradoxically old-fashioned-looking. It is precisely these characteristics, however, that make the phones interesting; that make you look twice and pause to try to make sense of them. If they looked less clunky and more sleek, less mechanical and more digital, less absurd and more logical then people would be more likely to overlook them.

Dourish and Bell argued that messiness was more compelling than tidiness. Chalmers argued that seams were beautiful and necessary because seams, gaps, edges and flaws give us something to grasp so that we can begin to understand invisible computer systems, especially in the context of ubiquitous computing. It is unlikely that Dourish, Bell or Chalmers had critical design or projects like my phones in mind when they were writing. However, I found that my experiences designing and using my phones bore out what they wrote about the merits of mess and seams and, I believe,

extend their arguments. Seamful, messy and imperfect designs open up the technology for examination much more than seamless, smooth and perfectly functional ones do.

Another one of my original research questions was whether there was an alternative to shrinking mobile phone obsolescence cycles. My projects do not provide a literal solution to this problem but do suggest different outlooks on the problem. First, if we can expand the definition of the mobile phone from simply a hardware device to include what we do with it as well as all its support systems (human, economic, cultural) then, presumably, we can also expand the definition to include the mobile phone's waste stream and the environment. Second, we can place a greater value on fostering persistence rather than creating obsolescence. My projects incorporated the old into the new and blended and combined different technologies to create new hybrids. In the process, they also proved the persistence of the rotary dial telephone in contemporary Canada. Taking an inclusive, both/and approach to design, rather than the exclusionary one implied by mainstream marketing and rapid obsolescence, is more than an abstract position or pie in the sky; it has practical implications for design and innovation. It suggests, as Rangaswamy did, that we need to design for heterogeneity, a range of human capabilities and technical hardware co-existing in the same space, cost effective adaptation rather than expensive replacement and open systems that increase people's options rather than closed black boxes that limit them.

My last research question had to do, more broadly, with the implications for technological innovation and I have already touched upon it above. My phone projects proved that re-using old things in new ways could be creative and innovative. Innovation, therefore, does not just happen on the bleeding edge of technology.

Chapter 7

Conclusion

Chapter Seven – Conclusion

My thesis research was inspired by the long life span of the mobile phone in the east compared to ever-shortening obsolescence cycles in the west. Originally envisioned as research into ways to repurpose mobile phones, my projects ultimately demonstrated ways to repurpose even older rotary dial phone hardware, combining it with other available technologies and even human beings located in other parts of the world, in order to recreate and reconsider smartphone functionality, thereby demonstrating the extent to which phone technology can be repurposed and phone life span can be extended. My literature review established a critical foundation for my research built on the themes of the mobile phone in India, ubiquitous computing, the merits of seams and messiness, UbiComp of today (not tomorrow), the concept of persistence (as opposed to obsolescence) and actor-network-theory. My review of critical, place-based and participatory art and design practices steered my research in an important new direction and led to a number of conceptual and interactive projects: *Upcycling #1: The Really Smart Phone*, *Upcycling#2: Heavy Duty Mobile Phone*, *stereoPHONEic* and *textDIAL*. While none of these smartphone proposals is commercially viable, each of them demonstrates the critical value of deliberate seamfulness, mess, dysfunction and absurdity — all things that designers are traditionally trained to work out of their designs.

My projects were not meant as an homage to old technology. The experiences of using them, whether real (lugging around a heavy phone on my belt, texting using a dial interface with no visual display for feedback) or imagined (hauling a hypothetical book truck with four phones and a battery onto a streetcar) constantly reminded me of how great a real smartphone is, which in turn, brought me back to the discoveries I

made in India the previous summer about the sheer impact of the mobile phone in developing countries and how nice it was to travel with a smartphone and stay connected on social media. In a sense, then, my projects were a celebration of the mobile phone and my growing appreciation of it over the last year and a half.

Future directions for my research include the following: first, and most immediately, completing the Indian call-centre component of *textDIAL*; second, extending my research from the phones on the network to the network itself. I.e. how to combine available technologies, and even human beings at times, to build a network with Internet functionality, without using the Internet itself.

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Appendix A

The Mobile Phone in India

Appendix A – The Mobile Phone in India

This appendix provides additional background information regarding my observations of the mobile phone in India and the work done at the DEF in the summer of 2012.

Methodology

We gathered information from a range of primary and secondary sources during a four-week period from mid-June to mid-July, 2012. Primary research included field visits to Gaffar Market, Nehru Place, Seelampur and Mustafabad in Delhi and Manesh Market and Saki Naka in Mumbai. It also included interviews with government officials from the Department of Information Technology in the Ministry of Communication and the Central Pollution Control Board; with NGOs and social enterprise organizations such as Toxics Link, SMS One, RML and EKO Services; with telecom manufacturers such as Nokia; with industrial e-waste companies such as Eco-Reco; and with academics and researchers such as Nimmi Rangaswamy from Microsoft's Technology for Emerging Markets group and Assa Doron with the Australian National University. Secondary research included international reports, Indian Government regulations (e.g. the new e-waste Rules and Guidelines), papers by specialists in the field, articles, stakeholder websites and blogs, opinion-pieces and online videos.

The mobile phone is no longer a luxury

The mobile phone is ubiquitous in India because, for most, it has become a necessity of life and is no longer a luxury item for the lucky few and the upper classes. It has been widely observed and reported how even relatively poor families will chose to spend a disproportionate amount of their income on a mobile phone. For example, in

“Rural India Calling,” Shilpa Sharma described how mobile phones are considered a necessary investment comparable in importance to other first purchases for the rural poor:

With an average household income of Rs. 4000/- per month, a rural Indian perceives mobile phone as an investment, and not an indulgence. This is an interesting insight that debunks the common perception wherein a mobile phone implies additional expense and thus becomes avoidable. Mobile Phone is fast catching on with a bicycle, radio, alarm clock to be the first durable that a rural Indian is purchasing (Sharma 2).

2011 census data also revealed that more households in India have mobile phones than toilets, something that made for sensational headlines at the time, but highlighted how important the mobile phone had become even for people below the poverty line:

New data from the country’s 2001 census shows 59% of Indian households have a mobile phone. Only 47% have a toilet on the premises (and that includes pit latrines that don’t use running water) (Censky).

For many people, the mobile phone provides their first experience of access to information and communication technologies and, thanks to the convergence of so many functions in one device, to a whole range of tools, entertainment, household goods and gadgets: banking, medical advice, movies, television, music, market information, bus and train reservations, the school principal’s office, advertising, grassroots media, camera, torch/flashlight, newspaper, maps, games, photo albums, alarm clock, watch, calculator, calendar, file cabinet and so on.

The Importance of the Mobile Phone in India

According to Osama Manzar of DEF, Rantej Singh of RML, Ravi Ghate of the Community Newsletter in Pune, Anupam Varghese of EKO Services and Assa Doron of the Australian National University, the mobile phone also has an enormous potential

for empowerment; for providing previously unavailable access to information and networks for micro- and small- enterprises and for improving the lives of the disenfranchised and those living below the poverty line. See below for a short survey of grassroots empowerment and development projects in a range of fields — agriculture, personal banking, democratic rights, and community services — each of which is designed for the mobile phone platform and simple and low-cost handsets.

SMS One Community Newsletter, Pune – community information



Figure 21: Street corner chalkboards used to be used for community communication before the SMS One Community Newsletter, Pune

A super-local community messaging service that delivers local Panchayat-level social service messages such as for blood drives and upcoming health clinics as well as more promotional messages to community members who previously had to rely on street corner blackboards like in the photograph above for their information. Here's how it works: a manager builds a subscription base of 1000 to 2500 people within a given community, for whom the service is free of charge. The manager then charges the sender of the messages depending on the type of message and keeps a portion for him or herself as income.

Source: Interviews with Ravi Ghate, Director, SMS One, www.smsone.in

Vote Report India – democratic rights



Figure 22: Screenshot of Vote Report India crowdsourced webmapping.
(Image by Vote Report India. Source:
<http://blog.ushahidi.com/2009/04/07/vote-report-india-launches/>)

An example of crowd-sourced crisis mapping using open source Ushihidi and SwiftRiver software, VRI was launched to track election violations during the 2009 general elections. It works by aggregating incoming reports from any citizen on the ground, organizing them in a map-based interface, filtering them and sending relevant information back out to the field. Reports can be made by SMS/text, email or web, but SMS is the most immediate.

VRI empowers by creating transparency and tracking transgressions in real time, not after the fact. It gives people the power to create and disseminate information that is important to them without having to go through the usual gatekeepers (authorities, politicians, media channels).

Source: website, <http://votereportindia.pbworks.com/w/page/7646284/FrontPage>

Reuters Market Light (RML) – small scale farming

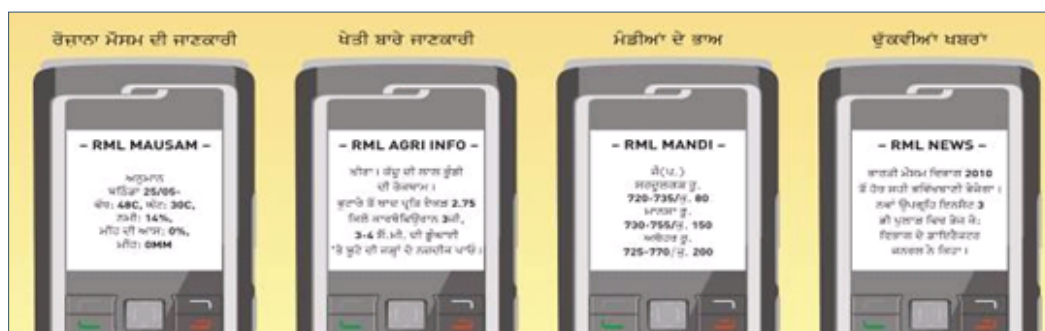


Figure 23: RML interface designed for simple devices and different regional dialects. (Image by RML.
Source: Rantej Singh, RML)

An initiative of Thomson Reuters, RML makes local and personalized agricultural information available to Indian farmers who previously had to rely on word of mouth or the word of self-interested middlemen and traders. Here's how it works: for Rs. 99/month or Rs. 999/year a farmer can subscribe via any brand of mobile and any service provider. After selecting which crops they are interested in and their preference out of 8 dialects offered, they receive 4 messages a day with market and weather information customized to their crops, location and language as well as advice on fertilizers, water, seeds, soil, fire etc. The objective is to empower to have higher yields and get better prices at market by having access to highly customized, timely and practical information. RML is designed to work on every type of mobile phone starting from the simplest text-based handset because SMS is the preferred medium of communication for small farmers according to Rantej Singh, from RML.

Source: Rantej Singh, Thomson Reuters, www.reutersmarketlight.com

EKO-Services – personal banking



Figure 24: Typical EKO customer service point. Transactions are designed for the simplest handsets on the market. (Source: Pereira. <https://techwow.wordpress.com/author/brian9p/page/4/>)

EKO Services provides basic banking services (deposit, withdrawal and secure money transfer) to the previously unbanked: the poor, the migrant worker, the innumerate and the illiterate. Requiring only touch-tone dial functionality, it is designed to work on the most basic handset, with an interface that is familiar to any prepaid mobile phone user who has ever recharged their mobile. Last year it had over 180,000 users and handled Rs. 400 crore (\$800,000) in transactions.

Source: Anupam Varghese, VP Design, EKO Services, eko.co.in/index.php, [youtube.com/watch?v=ROgA95ghm-k](https://www.youtube.com/watch?v=ROgA95ghm-k)

Mobile phone vs. the Internet

In the west, the computer evolved from the mainframe computer, to the personal computer and then to mobile technologies and social media. In many other parts of the world, however, things took a different course. In India, the mobile phone enjoyed more popularity and deeper penetration than either the personal computer or the Internet ever did. In fact, many of the rural population (that comprises 70% of the country) and the urban poor “skipped the landline telecommunication and Internet age and leapt straight to adopt mobile telephony” (Sharma 1). For many, she continues, “mobiles offered their first exposure to digital technology of any kind” (Sharma 1). The reasons for this are many. They include historically poor Internet service in rural areas, historically slow Internet service and narrow bandwidth and an unreliable electrical power supply, even in the major metro cities and the nation’s capital. According to *The Internet In India* power surges and brown-outs that wear out computers and modems are common in most parts of the country including the metros, but especially in rural areas. Mobile phones that only need to be charged a few hours a day or a week are much better suited to these conditions than are computers with Internet connections. Mobile phones, furthermore are simpler and less daunting to use than computers and the Internet, especially for the innumerate and illiterate or people who don’t speak English. Internet subscription rates were relatively expensive and came with contracts. Mobile phone rates, by contrast are inexpensive and flexible. Lastly, mobile phones are relatively inexpensive, increasingly popular thanks to smartphone and 3G technology and, to state the obvious, mobile.

Social, economic and cultural patterns of Indian mobile phone use

Indian mobile phone culture is characterized by the following:

- The informal economy (Rangaswamy 559).
- Phone re-use and refurbishment: One reason that the Indian mobile phone lifespan is so long is the tendency to repair, refurbish, re-purpose and re-use mobile phones (Rangaswamy 559).
- Multiple phone ownership: Much more so than in the west, it is very common in India to own more than one phone or to own a dual-SIM card phone. By December 2009, it was already reported that the average Indian mobile owner had 1.8 phones (Stevens) and this rate has probably increased since then.



Figure 25: One person proudly displays her four working mobile phones

- Little recycling culture: Mobile phone recycling rates are very low in India. According to Priti Mahesh of Toxics Link (Mahesh) and Pranshu Singhal of Nokia (Singhal), there is a tendency to stash old mobiles in a desk drawer rather than dispose of them properly, just in case, and that this phenomenon is especially prevalent with mobile phones because of their small size.
- Informal e-waste recycling: Like waste-handling in general, the e-waste industry is currently dominated by the informal economy. Presently, only 5% of the country's e-waste is recycled by licensed operators (MAIT-GTZ 1).

Typical mobile phone and e-waste hotspots

In Indian cities, certain products and services are often concentrated in particular markets and neighbourhoods (spice market, jewellery market, car stripping, e-waste handling etc.), which become magnets for both customers and related other associated service providers (parts buyers, distributors etc.). Electronics, second-hand phone sales, repairs and e-waste handling are also offered through a well-established infrastructure of niche markets, hotspots and neighbourhoods. We visited a number of such markets and neighbourhoods and made the following observations. Specializing in computers, mobile phones or one type of electronics or another and comprising of independent small- and micro-enterprise storefront businesses, with each shop offering its own combination of complementary services: repairs, second hand phone sales, low-cost or counterfeit 'China-made' phones, SIM cards, batteries and phone accessories, unlocking, software updates and talk-time recharging. This section will describe a number of these areas in Delhi and Mumbai.

Gaffar Market, Delhi

Located in the Karol Bagh area of west Delhi, Gaffar Market is located in a mixed neighbourhood consisting of Sikh, Hindu and Muslim communities, Gaffar Market is known for mobile phone sales and service and sales of a range of counterfeit products. It also has a reputation for laundering stolen property.

With too many individual mobile phone and repair shops to count, Gaffar Market offered a wider range of options (name brands/Indian-made/'China-made', price point, new/second hand, accessories, peripherals, SIM cards, recharging etc.) than could be found at any particular name-brand store or service centre elsewhere and

seemed to create a critical mass that attracted a high volume of customers even on a weekday.

We observed that typical streets were pedestrian-only and flanked by rows of small one-storey shops, which housed small businesses. Sidewalk space in front of the shops was commonly rented out to even smaller dealers sitting behind individual display cases often as little as thirty inches wide. These sidewalk businesses may or may not have had names on display. We observed repairs being done on the spot.

Manish Market, Mumbai

Located in south Mumbai, Manish Market is a well-known market for Chinese-made and counterfeit mobile phones and accessories (Henschall). A four storey building reportedly crowded with mobile phone retail and wholesale shops with the usual smaller display-case businesses located in front (Henschall), the building was gutted by fire in November of 2011 and was in the process of being repaired when we visited. Photos and stories in online blogs, however, give a sense of what the market used to be like and reinforced what we observed about small display case businesses in front of other businesses, hawkers on foot, curious Chinese brands and counterfeits. , Stuart Henschall again: “For the most part the phones are very “foreign” here. They aren’t “name” brands. Where one sees name brands they are either “second hand trade-ins” or “fakes”.

Nehru Place Market, Delhi

Claiming to be Asia’s largest computer hardware market, Nehru Place is located in the lower two levels of six to nine story Brutalist concrete commercial building complex in south Delhi and is another computer and electronics hotspot in the National

Capital Region selling phones, computers, peripherals, accessories, software and services. Once again, a formal count of the mobile phone and repair shops was outside of the scope of the study but the impression is that there are one or two hundred - alone.

We observed many business operating out of 50 to 80 sq.ft spaces with service counters in front for dealing with customers and displays, stock or repair space behind. Other even smaller businesses worked out of small display cases or cardboard boxes on the sidewalk in front. Still other hawkers milled about selling software, laptop lamination etc. on foot. Public thoroughfares were crowded with “Mobile Repair” signs competing with each other for attention. Once again, we observed repair counters visible in the shops and on-the-spot repair work in progress. Many repair shops also sold second hand phones, new Indian copycat phones (such as Micromax, Spice and Karbonn that offer the features of major brand name smart phones but at reduced quality) and ‘China-made’ phones. This range of options and price-points suggests one reason why mobile phones are so accessible in India.

Seelampur and Mustafabad

Two dense urban slum area in east Delhi east of the Yamuna River, Seelampur and Mustafabad, eight kilometers to the north, are both associated with e-waste recycling and the informal economy (DEF discussions, SVTC). I observed that both consist of fairly dense streets of random two and three storey attached brick and concrete buildings with small shops (a.k.a ‘go-downs’ - small, typically one-room, no-frills workspaces) at street level where various e-waste operations take place in clear view from the street. Homes and businesses are located above. Some roads are paved, others not. Recycling tends to be clustered in certain ‘galis’, or alleys, where certain functions (disassembling,

wire-stripping, sorting, packing and delivering) spill out from the ‘go-downs’ into the street and stacks of picture tubes packed in Styrofoam and piles of circuit boards, plastic monitor bodies and other electronic debris can be found lining the streets. See photos below.

Typically, phones and other electronics are broken down and separated so that every possible part and material can be aggregated, re-used or recycled in one way or another and nothing goes to waste (something that suggests the effectiveness of the informal e-waste sector, at least in terms of simple volume, if not material recovery rates).

Incorporating the informal into the formal economy

The informal economy is sizeable and contributes significantly to the long life span of the mobile phone in India. The illegal e-waste recycling industry, for example, provides a livelihood for hundreds of thousands of households nationwide. Estimates are that 25,000 people in the National Capital Region alone are employed in it (Silicon Valley Toxics Coalition, Chintan and Arjun Bhagat). While probably unrealistic anyway, eliminating the informal e-waste sector and displacing so many people could have dire social consequences. The informal sector, furthermore, is mature, savvy and well-connected and there is much to be learned from its business models (Doron, Maheshwari). Eliminating the sector, therefore, could also represent a loss of informal business knowledge.

Suggesting that people currently employed in the informal e-waste sector could simply get jobs in the new industrialized e-waste factories is unrealistic for a number of reasons. According to Anuj Maheshwari, of Eco-Reco, a Mumbai-based industrial e-

waste recycler, past efforts to incorporate informal sector workers into formal recycling factory operations have failed because many of the workers are accustomed to being small business entrepreneurs responsible for making their own business decisions and maintaining their business networks - and don't want factory jobs. Also, it would likely mean being dislocated from home (Maheshwari).

Formalizing the informal, or incorporating the informal into the formal sector, may be a more realistic and complementary approach to the mobile phone industry and could transform the e-waste industry into a viable, efficient and environmentally-friendly one, according to the proponents of this approach. Anuj Maheshwari, from Eco-Reco, indicated that collection had proved to be unprofitable and frustrating for Eco-Reco and, as a result, his company would prefer to simply leave it up to existing collectors so that they can focus on what is most profitable for them (Maheshwari). Sandip Chatterjee, furthermore, believes that India needs a home-made solution to its e-waste issues: one that realistically addresses the domestic conditions (the size and domination of the informal economy, appropriate technologies, Indian labour costs etc.), incorporates the informal sector into a new e-waste business model and is driven by a viable profit model that is economically sustainable and encourages all parties to participate fully. New laws, he says, are not enough. The only way to discourage damaging recycling practices is to provide an "alternative earning mechanism" (Chatterjee, "Sustainable Electronic Waste Management" 23, Chatterjee discussion) for the informal society. He proposes:

... an outsourced model where equal participation of the organised and unorganised sector is ensured to make the e-waste management business a profitable one ... In the proposed approach, unorganised operators will concentrate on collection, disassembly, segregation of e-waste, whereas, organised sector will concentrate on

processing the PCBs to extract precious metals. (Chatterjee, “Sustainable Electronic Waste Management” 23)

If his numbers are correct, the informal sector would concentrate on what it is good at (social networking, collection, disassembly, segregation), the formal sector could concentrate on what it is really good at (PCB processing and the extraction of precious metals) and neither would lose its current market share.



Figure 26: China-made and 2- and 3-SIM card phones are big sellers in Gaffar Market, Delhi

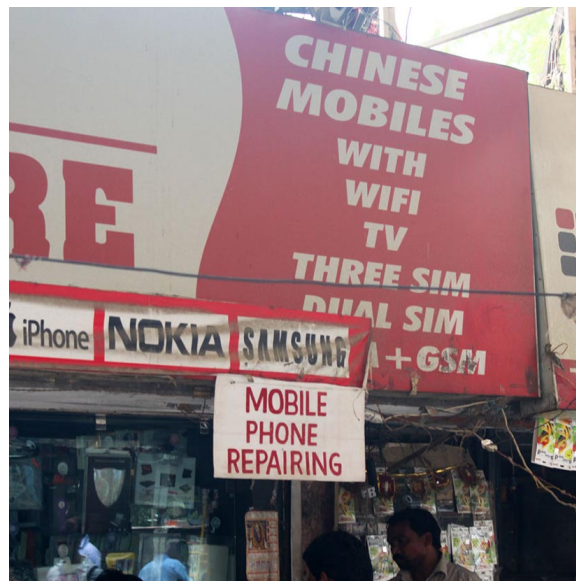


Figure 27: Typical display case-based business in front of a shop in Gaffar Market, Delhi



Figure 28: Mobile repair shops compete for attention in Nehru Place Market, Delhi

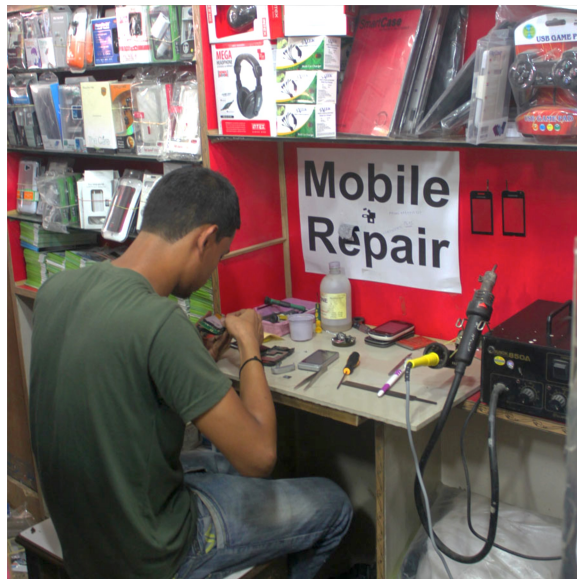


Figure 29: Repairs are made on the spot in Nehru Place Market.



Figure 30: Typically busy shops at Nehru Place Market offer wide range of sales and services

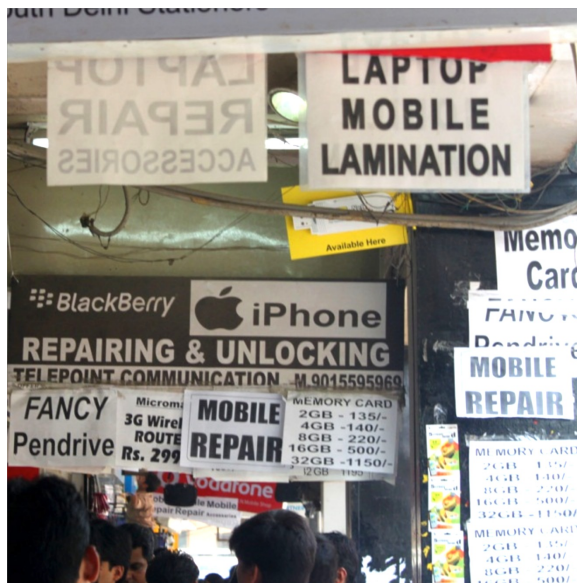


Figure 31: Ads for mobile phone repairs, services and accessories crowd the aisles at Nehru Place Market, Delhi



Figure 32: Counterfeit 'Sumsmug' phone with asking price of Rs. 2,00 (\$56) before bargaining means it could be bought for far far less, at Manesh Market, Mumbai.



Figure 33: Very convincing counterfeit iPhone 4S complete with packaging and all accessories, at Manesh Market, Mumbai



Figure 34: Computer monitors brought to picture-tube recycler in Mustafabad, Delhi



Figure 35: Printed circuit boards (PCBs) piled high in the street in Mustafabad, Delhi



Figure 36: Monitors being packed for shipment to larger e-scrap dealer, Mustafabad, Delhi



Figure 37: After removing the valuable picture tubes, the monitor cases wait to be sold to the plastics recycler

Appendix B

Art References

Appendix B - Art References

Ghana Think Tank

Ghana Think Tank

www.ghanathinktank.org



Figure 38: Ghana Think Tank rolls into Queens, NY. (Source: <http://blackrockarts.blogspot.ca/2011/06/ghana-think-tank-2011-grantee.html>)

Originally held in Ghana, Cuba and El Salvador, *Ghana Think Tanks* have since been organized in a variety of locations around the world, always pairing so-called ‘developed’ and ‘developing’ world communities. The Think Tank, as we know it, is typically a first-world institution associated with expert opinion, power to influence change and, sometimes, hidden agendas. GTT, by contrast, turns that metaphor on its head by asking developing world participants to solve local problems supplied by the first world participants (in, say, Liverpool or Berlin). The resulting grass roots solutions are then field tested where the problems originated, with varying results, according to GTT. “Some of these actions have produced workable solutions, but others have created intensely awkward situations, as we play out different cultures’ assumptions about each other” (Ghana Think Tank).

Think Tank experts have come from Morocco, Mexico, Ethiopia, Iran, Ghana, El Salvador, Gaza and Cuba, among others.

Ghana Think Tank is organized by Christopher Robbins, John Ewing, and Maria Del Carmen Montoya.

Call Cutta in a Box

Rimini Protokoll

www.rimini-protokoll.de/website/en/project_2766.html



Figure 39: The call-centre agent in Kolkata. (Source: Rimini Protokoll, http://www.rimini-protokoll.de/website/en/project_2766.html)



Figure 40: the European performer. (Source: Rimini Protokoll, http://www.rimini-protokoll.de/website/en/project_2766.html)

Rimini Protokoll (RP) is a German/Swiss performance collective consisting of Helgard Haug, Stefan Kaegi and Daniel Wetzl. Their work blends theatre, participation and live-art to explore site-specific issues and are enacted by non-professional actors and local residents (who RP calls ‘experts’).

Call Cutta in a Box

Dating from 2005, Call Cutta in a Box is two-person interactive theatre carried out between one call-centre employee in Calcutta and one participant in a northern European city and has been beautifully captured in the video that can be viewed at the website above.

Rather than buying a ticket, the audience member books an appointment and arrives at a generic-looking office, at which point she or he will receive a call from someone in Kolkata, and so the performance begins. The call-centre employee is working from a script but also has room to ad-lib. At first, he or she establishes the distance between the two actors but gradually and deliberately, collapses both the space and time difference between the two. By the end, they are signing and dancing together and have formed a genuinely intimate bond. So much so that when the call-centre agent finally says goodbye and the call ends, it feels like thousands of kilometers of distance and isolation are suddenly re-established, which is a hard enough thing to watch in the video. I imagine it could feel pretty devastating to experience as a participant.

Call Cutta in a Box is a globally-scaled performance piece designed to reverse our assumptions about people who work in call-centres and to create genuine connections between people in very different contexts.

Homeless Vehicle

Krystoff Wodiczko with David Lurie
1988-89



Figure 41: The *Homeless Vehicle* on the streets of New York City. (Source: <http://www.medienkunstnetz.de/works/homeless-vehicles/>)

Intended to address the homeless shelter gap in New York City in 1988, the *Homeless Vehicle* was designed, on one level, with input from the homeless community to address their everyday reality and basic needs: shelter, a place to sleep, a continual state of mobility resulting from their property-less status, storage for personal belongings and to support a scavenger lifestyle (Wodiczko 82). On another level, it was designed to help identify the real needs of a sector of the population that is often overlooked or seen as ‘identity-free objects’ (Wodiczko 81) and to increase the visibility of this group — hence it resembles a weapon (Wodiczko 83) and has a high-polished finish.

Placebo

Anthony Dunne and Fiona Raby

www.dunneandraby.co.uk/content/projects/70/0

2001



Figure 42: The *Placebo* pieces. (Source: Khuuphoria's Blog, <http://khuuphoria.wordpress.com/>)



Figure 43: *The Electricity Drain*.

(Source: Dunne and Raby website,
[http://www.dunneandraby.co.uk/
content/projects/70/0](http://www.dunneandraby.co.uk/content/projects/70/0))

The *Placebo* project consists of the eight elements shown in the left hand image, which were individually placed in people's homes in order to investigate their occupants' attitudes towards electromagnetic fields in the home. One of the prototypes, *The*

Electricity Drain is shown in use in the image on the right. In this case, the occupant believed that she was very sensitive to static electricity in the house and that by putting her hand on the metal surface of the table, she could drain electrical charges away from her. She placed the table in the sitting room because that was where the television was (Dunne and Raby no page number).

The *Placebo* pieces are highly stylized, “purposely diagrammatic” (Dunne and Raby 75), and not meant for comfort. Although the image on the right could be confused with a gallery setting, Dunne and Raby stress that their pieces are not intended for gallery settings, but are meant to be experienced in everyday settings by everyday people. They are also not meant for mass-production but, as Dunne and Raby write, “Designers cannot always solve problems, we cannot switch off the vast electromagnetic networks surrounding us all. Although we cannot change reality, we can change people’s perception of it” (Dunne and Raby 75).

Feral Robotic Dogs

Natalie Jeremijenko

www.nyu.edu/projects/xdesign/feralrobots/projectindex.html
2002 and ongoing



Figure 44: Various *Feral Robotic Dogs*. (Source: <http://www.nyu.edu/projects/xdesign/feralrobots/upgradeindex.html>)



Figure 45: *Feral Robotic Dogs* off-leash in the Bronx. (Source: <http://www.nyu.edu/projects/xdesign/presentation.html>)

Feral Robotic Dogs are hacked and repurposed off-the-shelf toy robot dogs that can detect (sniff out) radioactivity levels that exceed acceptable EPA standards in soil and point them out by walking toward the highest concentrations (Freyer, Conny and Sebastien 228). The dogs are designed to be made and released by community activists wherever there are concerns with contaminated soil conditions. They are also designed for maximum dramatic impact and media attention.

As part of the work of Jeremijenko's BIT Lab (Bureau of Inverse Technologies), current research includes ways to extend the feral dog metaphor by networking the dogs together, thus creating pack behaviour that reinforces the impact of the visualization and ramps up the spectacle of the event (Jeremijenko).

Appendix C

Code

Appendix C – Code

stereoPHONEic

```
/*
stereoPHONEic
This sketch operates the MP3 shield and Arduino board, has play track, pause, resume,
stop and volume up and down functions.
Author: Anne Stevens
Date: 2 February, 2013, Groundhog Day
*/

//MP3 libraries
#include <SPI.h>
#include <SdFat.h>
#include <SdFatUtil.h>
#include <SFEMP3Shield.h>

SFEMP3Shield MP3player;

// constants
int dialPin = 5; // input from dial
int switchDebounce = 10; // delay between individual high/low switches
                          // when a number is dialed
int dialDebounce = 100; // delay to make sure dial has stopped turning

// variables
int playState; // playState = 0 if track stopped, = 1 if playing
int dialed; // value from 1 to 10 from dial
boolean dialHasBeenDialed = false; // if true then send number to MP3 library
int lastplayState = LOW; // to determine if dial state has changed
                          // from dialing to stopped or vice versa
int currentplayState = LOW; // is the dial turning or not
long lastplayStateChangeTime = 0; // timer when the dial state changed last time
int defVolume = 4; // number of times to nudge default volume up

void setup() {

  Serial.begin(9600);
  pinMode(dialPin, INPUT);
  MP3player.begin(); //start the shield
  playState = 0;
```

```
for(int i = 0; i < defVolume; i++) // to increase default volume
{
  volumeChange(10);
}

void loop() {
  int reading = digitalRead(dialPin); // if the dial is turning, reading == HIGH
  if(reading != lastplayState) {      // if the dial was stopped and is now turning or
                                      // vice versa
    lastplayStateChangeTime = millis(); // if so, set this time
  }

  // if it's paused long enough to be sure this isn't just noise
  if ((millis() - lastplayStateChangeTime) > switchDebounce) {

    if(reading != currentplayState) {
      currentplayState = reading;

      if (currentplayState == HIGH) {
        dialed++; // counts the number of switches for the number dialed
        dialHasBeenDialed = 1;
      }
    }

    // if it's paused long enough to be sure this isn't just noise
    if ((millis() - lastplayStateChangeTime) > dialDebounce) {

      if(dialHasBeenDialed) {

        if(dialed >= 1 && dialed <= 6) { //if #1 to #6 keys pressed, play track
          playTrack(dialed);

        } else if (dialed == 8) { //if 's' key pressed, stop the track
          stopTrack();

        } else if ( dialed == 9) { // if 'p', toggle b/t pause & resume
          pauseResume();

        } else if ((dialed == 7) || (dialed == 10)) { // volume down or up
          volumeChange(dialed);
        }

        dialHasBeenDialed = 0;
        dialed = 0;
      }
    }
  }
}
```

```
    }

    lastplayState = reading;
}

// pauseResume function toggles between pause and play
void pauseResume() {
    if(playState == 1) {

        MP3player.pauseDataStream();    // pause the track
        playState = 0;

    } else if(playState == 0) {
        MP3player.resumeDataStream();    //resume the track
        playState = 1;
    }
}

// playTrack function plays the track
void playTrack(int num) {

    if(playState == 1) {    // if a track is playing, stop it so that a new track can start
        stopTrack();
        // Serial.print("playState after stop = ");
        // Serial.println(playState);
    }

    MP3player.playTrack(num);    //start playing track
    playState = 1;
    // Serial.print("playState after playTrack = ");
    // Serial.println(playState);
}

// stopTrack function stops the track
void stopTrack() {
    MP3player.stopTrack();    // stop the track
    playState = 0;
}
```

textDIAL

This project requires three sketches:

1. Arduino sketch to read the dials and send the phone and dial number in "a,b" format to the Processing sketch
2. Arduino sketch to play the instructions when the handset is lifted and the hook switch is raised.
3. Processing sketch to display the outgoing message

```
/*
  textDIAL
  Arduino sketch to read the dials and send the phone and dial number in "a,b" format
  to the Processing sketch where "a" is the phone number and "b" is the number dialed.
  Author: Anne Stevens
  30 March, 2013
  Thanks to guidomax's sketch at instructables.com
*/

//variables
// each phone is connected to one pin on the Arduino
int phonePin0 = 10;
int phonePin1 = 11;
int phonePin2 = 12;
int phonePin3 = 5;

// array of the 4 phonePins
int readings[4];
int phonePins[4] = {phonePin0, phonePin1, phonePin2, phonePin3};

// variables related to dialing the dial
int lastState = LOW;           // used to tell countNum function when switch
                                // has changed from LOW to HIGH or vice versa
int trueState = LOW;           // used to tell countNum function when to count
long lastStateChangeTime = 0; // time in milliseconds when lastState changed
int phoneNum;                  // the number of the phone between 0 and 3
int reading;                    // HIGH when a phone is dialed
boolean needToPrint = false;   // tells sendNum when to print number to Serial
int count;                     // counts the number of times dial switch is switched

// constants
int dialHasFinishedRotatingAfterMs = 100; // to confirm that dial has finished
dialing
int debounceDelay = 30;          // to confirm dial switch has finished switching
```

```
void setup() {
  Serial.begin(9600);                // Serial monitor baud rate

  // set pins as input
  pinMode(phonePin0, INPUT);
  pinMode(phonePin1, INPUT);
  pinMode(phonePin2, INPUT);
  pinMode(phonePin3, INPUT);
}

void loop() {

  readPhones();                     // call the readPhones function
  countNum();                       // call the countNum function
  sendNum();                        // call the sendNum function
}

// when a phone is dialed, read which phone and which number was dialed
void readPhones() {

  for (int i = 0; i < 4; i++){      // go through each phonePin
    readings[i] = digitalRead(phonePins[i]); // read the pin
  }

  if (readings[0] == HIGH) {        // if the reading on this phonePin is HIGH
    reading = readings[0];          // reading = 0
    phoneNum = 0;                  // phoneNum = 0
  }
  else if (readings[1] == HIGH) {   // repeat for each of the 4 phonePins
    reading = readings[1];
    phoneNum = 1;
  }
  else if (readings[2] == HIGH) {
    reading = readings[2];
    phoneNum = 2;
  }
  else if (readings[3] == HIGH) {
    reading = readings[3];
    phoneNum = 3;
  }
  else {
    reading = LOW;
  }
}
```

```
// function that counts how many times the dial switch is switched when the dial is
// dialed
void countNum() {

    if (reading != lastState) {                // if reading has changed from LOW to HIGH
                                                // or vice versa
        lastStateChangeTime = millis();        // take the time in milliseconds
    }

    if ((millis() - lastStateChangeTime) > debounceDelay) { // after debounceDelay has
                                                            // passed and dial has stablized
        if (reading != trueState) {            // this means that the switch has either
                                                //just gone from closed to open or vice versa.

            trueState = reading;                // trueState becomes reading

            // if trueState is HIGH, count it. Otherwise, don't count it. This way it counts each
            // time the dial switch is switched on, not every time it changes from HIGH to
            // LOW and back
            if (trueState == HIGH) {
                count++;                        // increment the count of pulses
                needToPrint = 1;                // turn on 'needToPrint'
            }
        }
    }
}

// function to Serial print the number of the phone number and the number dialed
void sendNum() {

    // if the dial has stopped dialing
    if ((millis() - lastStateChangeTime) > dialHasFinishedRotatingAfterMs) {

        // send the phone and dialed numbers in "a,b" format
        if (needToPrint) {
            Serial.print(phoneNum);            // Serial print the phoneNum
            Serial.print(",");                  // Serial print ","
            Serial.println(count);              // Serial print the number dialed
            needToPrint = 0;                    // reset to "0" after the number is sent
            count = 0;                          // reset count to "0" after the numbers are sent
        }
    }

    lastState = reading;                        // change lastState to reading
}
```



```
/*
textDIAL
  Arduino sketch to play the instructions when the handset is lifted and the hook switch
  is raised.
  Instructions are recorded to a file called "instruct.mp3".
  Switch also connected to 5V and ground via a 10K resistor
  Author: Anne Stevens
  20 March, 2013
*/

//MP3 shield libraries
#include <SPI.h>
#include <SdFat.h>
#include <SdFatUtil.h>
#include <SFEMP3Shield.h>

SFEMP3Shield MP3player;

// constants and variables
const int hookSwitchPin = A0;
int hookSwitchState = 0;
int playState;

void setup() {
  Serial.begin(9600);           // Serial monitor baud rate
  MP3player.begin();           //start the shield

  pinMode(hookSwitchPin, INPUT); // initialize the digital pin as input and output.
  playState = 0;                // the track is no longer playing
}

void loop() {

  if(digitalRead(hookSwitchPin) == LOW) { // If hook switch is down
    MP3player.stopTrack();                // stop the track with the instructions
    playState = 0;                        // reset playState to 0
  } else {                                // if hook switch is up, i.e. hookSwitchState = HIGH

    if(playState == 0) {                  // is the track is not playing
      MP3player.playMP3("instruct.mp3"); // play the file with the instructions
      playState = 1;                      // indicates that a track is playing
    }
  }
}
```

```
/*
  textDIAL
  Processing sketch to display the outgoing message
  Author: Anne Stevens
  29 March, 2013
*/

import processing.serial.*;      // library req'd to read data coming in thru' serial port

// fonts
PFont regFont;
PFont boldFont;

// background display variables
int panelW;      // width of central white panel
int lEdge;       // left side of central white panel
int rEdge;       // right side of central white panel

// variables that control what happens when
int messageNum;  // = 1 for message, and = 2 for reply
int panelState;  // controls number of times white panel is drawn
int printState;  // controls whether to add letters to message String, print
                  // message, print reply, or reset "message" to empty String
int replyState;  // used with printState to control what happens next
int cursorState; // controls when to print blinking cursor
boolean blink;   // makes cursor blink on and off
int sendTime;    // used with millis() to control speed that letters print to display
int resetState;  // controls when to call resetStates() function

// Serial event and message String variables
Serial port;     // The serial port object
String inString; // stores incoming string from Serial, comes in the form "a,b"
int phone;       // phones are numbered from 0 to 3
int character;   // dial number on each phone, from 0 to 9

// printChar variables
int count;       // so that nothing prints before a phone has been dialed
char charToPrint; // the character to add to the message String in printChar
int printCharCount; // add the character to message String only once, in printChar
String newMessage = ""; // the new message being built in charToPrint function
String message = "";    // the message being displayed
String messages[] = new String [3]; // array of messages to be displayed
String reply = "Now compose a reply and dial SEND. "; // the reply String
String textToDisplay; // the text to display. Can be either message or reply Strings
```

```
// text position variables
int margin;      // margin between white panel edges and text
int textX;       // Xpos of message text display
int textY;       // Ypos of message text display
int replyX;      // Xpos of reply
int replyY;      // Ypos of reply
int cursorY;     // Ypos of cursor

// createWriter variables
int createState; // to control whether message should be added to the text file
PrintWriter output; // the message that gets saved into the text output file

// arrays of the characters on the dial of each phone
char [] ph0chars = {'1', '2', '3', '4', '5', '6', '7', '8', '9', '0'};
char [] ph1chars = {'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j'};
char [] ph2chars = {'k', 'l', 'm', 'n', 'o', 'p', 'q', 'r', 's', 't'};
char [] ph3chars = {'u', 'v', 'w', 'x', 'y', 'z', '!', ' ', ' ', ' ', ' ', ' '};

void setup() {

  // set initial states
  count = 0;
  panelState = 0;
  printState = 0;
  replyState = 0;
  cursorState = 0;
  createState = 0;
  blink = true;
  resetState = 0;

  // create empty message Strings
  messages[0] = "";
  messages[1] = "";
  messages[2] = "";

  // name the text file where the messages will be saved using createWriter
  output = createWriter("messages_19apr2013_3.txt");
  regFont = loadFont("Courier-36.vlw"); // regular font
  boldFont = loadFont("Courier-Bold-36.vlw"); // bold font

  smooth();
  noStroke();
}
```

```
// controls size and position of background display elements
size(1280, 780);           // overall display size
panelW = 950;              // width of central white panel
lEdge = width/2 - panelW/2; // left edge of central white panel
rEdge = width/2 + panelW/2; // right edge of central white panel
background(70);            // dark grey background

// draw the shadow behind the white panel
fill(50);                  // shadow colour
rect(lEdge - 10, 0, panelW + 20, height); // draws the shadow
filter(BLUR, 4);           // creates blur effect

// draw the central white panel
fill(255);
rect(lEdge, 0, panelW, height);

// print list of available ports
println(Serial.list());
port = new Serial(this, Serial.list()[0], 9600); // Choose your Serial port from lists
port.bufferUntil('\n');                          // Read into buffer until there's a line break
}

void draw() {

  // draw white panel on top of grey background
  if (panelState == 0) {
    drawPanel();           // calls the drawPanel() function
    panelState = 1;        // just draw it once
  }

  // display the message when Send is dialed
  if (printState == 0) {   // if ready to display

    if (phone == 3 && character == 9) { // if Send was dialed

      textFont(regFont, 24);           // use the regular font
      panelState = 0;                  // calls drawPanel() function
      sendTime = millis();              // take time when Send was dialed, in milliseconds
      printState = 1;                  // just do it once

      // changes position of previous messages to make room for new message
      messages[2] = messages[1];
      messages[1] = messages[0];
      messages[0] = message;
      message = newMessage;           // message to be printed is the newMessage from
                                      // printChar
    }
  }
}
```

```
    newMessage = "";           // resets newMessage to blank
    resetState = 1;
    character = 0;
    cursorState = 0;
  }
}

// as soon as there is a sendTime, call printMessage function to print the message
if (sendTime != 0 && printState == 1) {
  messageNum = 1;              // i.e. message should be printed, not reply
  printMessage(messageNum);    // call printMessage() function
}

// call printMessage again, to print the reply
if (printState == 2 && replyState == 1) {
  messageNum = 2;              // i.e. reply should be printed, not message
  printMessage(messageNum);    // call printMessage() function
}

// print the blinking cursor
if (cursorState == 1) {
  cursor();                    // call the cursor() function
  printState = 0;              // reset printState to 0

  if (resetState == 1) {
    resetStates();              // call the resetStates() function
    resetState = 0;            // resets resetState
  }
}

// function to draw the white panel in the centre of the display
void drawPanel() {

  fill(255);
  rect(lEdge, 0, panelW, height); // draw the central white panel
}

// function called whenever there is something available to read
void serialEvent(Serial port) {

  inString = port.readStringUntil('\n'); // reads the incoming string in format "a,b"
  inString = trim(inString);            // trims the string
}
```

```
String [] phoneAndChar = split(inString, ","); // array with two numbers: a and b
phone = int(phoneAndChar[0]); // phone is the first number in the array
character = int(phoneAndChar[1]) - 1; // character is the second number in the array

count = count + 1; // the number of characters in the string
printCharCount = 0;
printChar(); // call printChar() function
}

// function to add character dialed to the message String
void printChar() {

    // determines which letter or number was dialed
    if (count != 0) { // prevents a 0 or 1 being printed before a phone has been dialed

        if (phone == 0) {
            charToPrint = ph0chars[character];
        }
        else if (phone == 1) {
            charToPrint = ph1chars[character];
        }
        else if (phone == 2) {
            charToPrint = ph2chars[character];
        }
        else {
            charToPrint = ph3chars[character];
        }
    }

    if (printCharCount == 0) {

        // backspace function deletes the last character in the message String
        String tempMessage = "";
        if (phone == 3 && character == 8) {
            for (int i = 0; i < newMessage.length() - 1; i++) {

                tempMessage = tempMessage + newMessage.charAt(i);
            }
            newMessage = tempMessage;
        } else {
            newMessage = newMessage + charToPrint; // add the last character dialed to
                                                    // newMessage
        }
    }
    printCharCount = 1; // so that each character is only be added once to the message
}
```

```
// function to display either message or reply Strings (depending if "num" is 1 or 2)
void printMessage(int num) {

    if (num == 1) {                // if the message is to be printed
        drawPanel();              // calls the drawPanel() function
        fill(0);
        textToDisplay = message;  // whether to display message or reply
        margin = 50;
        textY = 100;
        createState = 1;          // so that the message is saved to the text file

        // previous messages to be displayed at bottom of display
        text(messages[0], lEdge+60, textY+(height/2));
        text(messages[1], lEdge+60, textY+(height/2)+60);
        text(messages[2], lEdge+60, textY+(height/2)+120);

    } else {                       // if the reply is to be printed
        fill (150);
        textToDisplay = reply;
        margin = 100;
        textY = 170;
    }

    textX = lEdge + margin;

    int passedTime = millis() - sendTime; // calculates time passed since Send was dialed

    // types one letter at a time to the display
    for (int i = 0; i < textToDisplay.length(); i++) {

        if (passedTime > 100 * i || cursorState == 1) { // controls speed that letters are
                                                         // displayed
            textX = textX + 15;                          // sets Xpos of character

            if (textX > (rEdge - margin)) {                // if text wrap is necessary
                textX = lEdge + margin + 15;
                textY = textY + 30;
            }
            text(textToDisplay.charAt(i), textX, textY);  // types one letter

            if (i == (textToDisplay.length() - 1)) {      // if it is the last character
```

```
// if the message was displayed, then the Reply needs to be displayed next
if (printState == 1 && replyState == 0) {

    if (createWriterState == 1) {
        output.println(textToDisplay);
        createWriterState = 0;
    }

    printState = 2;                // ready to print the reply
    sendTime = millis() + 300;    // time that it became ready to print the reply
    replyState = 1;                // so that it only takes the time once
} else { // reply has been printed. Reset things so new message can be received
    cursorState = 1; // once the reply is printed, the cursor needs to start blinking
    printState = 3; // if reply was displayed then reset printState to 0
    textX = lEdge + margin;
    textY = 50;
}
}
}
}
}

// function to draw a blinking cursor after the reply is displayed
void cursor() {

    for (int i = 0; i < 1; i++) { // once
        cursorY = 230;
        drawPanel();             // redraw the white panel

        messageNum = 1; // so that the message can be reprinted on top of white panel
        textFont(regFont, 24);
        printMessage(messageNum); // calls the printMessage function

        messageNum = 2; // so that the reply can be reprinted on top of white panel
        textFont(boldFont, 24);
        printMessage(messageNum); // calls the printMessage function
    }

    // print the blinking cursor
    fill(0);
    if (blink) {
        textX = lEdge + margin;
        text("_", textX - 30, cursorY);
    }
    blink = !blink;
    delay(500);
}
```



```
// function to reset everything back to starting states so that a new message can be
// dialed
void resetStates() {

    replyState = 0;
    newMessage = "";
    textX = lEdge + margin;
}

// function to write data to a text file and close the file
void keyPressed() {
    if (key == '~') {
        output.flush();    // Writes the remaining data to the file
        output.close();    // Finishes the file
        exit();            // Stops the program
    }
}
```

