Urban Probes: Encountering Our Emerging Urban Atmospheres

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ABSTRACT
Urban Atmospheres captures a unique, synergistic moment – expanding urban populations, rapid adoption of Bluetooth mobile devices, tiny ad hoc sensor networks, and the widespread influence of wireless technologies across our growing urban landscapes. The United Nations recently reported that 48 percent of the world's population current live in urban areas and that this number is expected to exceed the 50 percent mark world wide by 2007 [1]. In developed nations the number of urban dwellers is even more dramatic – expected to exceed 75%. Current studies project Bluetooth-enabled devices to reach 5.4 billion units by 2005 – five times the number of mobile phones or Internet connections [2]. Mobile phone penetration already exceeds 80% of the population in places like the European Union (EU) and parts of Asia [3]. WiFi hardware is being deployed at the astonishing rate of one every 4 seconds globally [4]. We argue that now is the time to initiate inspirational research into the very essence of these newly emerging technological urban spaces. We desire to move towards an improved understanding of the emotional experience of urban life. This paper describes Urban Probes – a lightweight, provocative, intervention methodology designed to rapidly deconstruct urban situations, reveal new opportunities for technology in urban spaces, and guide future long term research in urban computing. We also describe a completed Urban Probe exploring urban trash.

ACM Classification: I.m Computing Methodologies; Misc.

Author Keywords
Urban computing, urban atmospheres, *dérive*, *détournement*

INTRODUCTION
There is little doubt that laptops, PDAs, and mobile phones have enabled computing to become a truly mobile experience. With these new computing devices, we emerge from our office, work, and school into the urban fabric of our cities and towns. We often view these urban areas as "in-between spaces" – obstacles to traverse from one place to another. However, not only do we spend a significant amount of time in such urban landscapes, but these spaces contribute to our own formulation of identity, community, and self. Much of the richness of life transpires within our own urban settings. The introduction of mobile computing tools upon our urban landscape affords new methods of viewing our city, community, and neighborhood. They can empower us to better understand our social relationship to community, place, and self. Similarly, there is a growing body of work within the field of social computing, particularly those involving social networking such as Tribe, Friendster, and Live Journal. At the intersection of mobile and social computing, we call for a discussion concerning research directed at understand this emerging space of computing within and across our public urban landscapes – Urban Atmospheres.

Urban Atmospheres
While toting a wireless laptop around a city may seem like an example of such city computing, Urban Atmospheres research is more deeply concerned with addressing four urban sub-themes. Each project is specifically designed to address some, but not necessarily all, of these sub-themes.

Place – What is the meaning of various public places? What cues do we use to interpret place and how will urban computing re-inform and alter our perception of various places?

Community – Who are the people we share our city with? How do they influence our urban landscape? Where do we belong in this social space and how do new technologies enable and disrupt feelings of community and belonging?

Infrastructure – How will buildings, subways, sidewalks, parking meters, and other conventional, physical artifacts on the urban landscape be used and re-appropriated by emerging technologies?

Traversal – What is a path or route through a city using these new urban tools? How will navigation and movement, either throughout an entire city or within a small urban space, be influenced by the introduction of urban computing technologies?

The single main research challenge of Urban Atmospheres is to understand how this future fabric of digital and wireless computing will influence, disrupt, expand, and be integrated into the social patterns existent within our public urban landscapes.

URBAN LIFE

The spectacular image of the modern urban city is that of a facilitator of commercial exchange, a place where people go to shop: the city as mall. The city is also a workplace – a center for government and business functions. While work, commerce, and business are the focus of cities, it is also a place for individuals and communities – a place where people can play. People come there to eat, drink, dance, meet friends, and just hang out. The potential for sociable exchange and the pursuit of happiness is vast. For its workers, the city also provides leisure zones – what Foucault calls "sites of temporary relaxation" [5].

However, the nature and locations of these social encounters are not always predictable. Whyte's "Street Life Project" [6] observed that usage of New York's downtown plazas varied wildly and bore little relation to extant theories of constructed space. Similarly, Lynch and Milgram exposed the difference between peoples' mental maps of the city and the physical city plan [7, 8]. Jacobs deconstructs and discusses the creation of small neighborhoods in cities [9]. Jain exposed how individuals used mobile phones within a city to influence the nature, negotiation, and navigation of urban space [10]. Public urban spaces also manifest a degree of anxiety and fear. The 1964 murder of Kitty Genovese exposed the tenuous and conditional links urban dwellers have to their neighbors and Familiar Strangers [11].

While massive physical changes are still rare in urban settings, a new social landscape is emerging. The extensive use of personal, wireless communication technologies has enabled behavior in urban spaces to transgress the lines and protocols between public and private space. Similarly, boundaries between home, office, automobile, and street are increasingly blurred [12].

Guy Debord and the Situationists [13] sought to reinvent everyday life in urban spaces by constructing situations which disrupted the ordinary and normal in order to jolt people out of their customary ways of thinking and acting. Using *dérive* (the urban flow of acts and encounters) and *détournement* (rerouting of events and images), the Situationist developed a number of experimental techniques that stressed the relationship between events, the environment, and its participants – our urban community.

As computer and social scientists we have the responsibility to look critically at such underlying forces and trends. In this paper we take the urbanist's perspective on the application of these new technologies within cities by their inhabitants. We think of the city not simply in spatial terms, but temporally. We are interested in the movement and activities of people as well as the familiar patterns [14] that comfort individuals within our seemingly chaotic, crowded urban landscape.

MOTIVATION

Only very recently have we seen the playful re-appropriation and novel uses of wireless devices and personal technologies in urban spaces. Such spaces contain trace elements of themes often found in traditional HCI literature such as those exploring actions in the home, office, school, automobile, *etc*. However, urban landscapes are both crowded and lonely, comforting and frightening, public and private, and shared and exclusive. Urban places and our actions there are critical to forming our understanding of community and belonging – often without directly interacting with members of the community.

Overall, while Urban Atmospheres can draw from foundations in HCI, we argue that it diverges significantly from traditional computing spaces, actions, objects, and communities. It also intersects a broad range of disciplines ranging from computer science and engineering to sociology and psychology as well as architecture and urban planning. As a result this work has been successful at engaging practitioners across these diverse research disciplines [15, 16].

Furthermore, with mobile and wireless devices in their infancy of adoption in urban life, we argue for a research methodology aimed at promoting a broad inspiration of urban possibilities. We have a unique opportunity, right now, to invigorate the very role that technology will play in our cities. For example, current research into urban systems such as location based services will undoubtedly provide important feedback for guiding the development of location based applications; and we applaud such research. However, we claim that a new methodology can complement the existing research by providing answers to broad challenges in this rapidly emerging space. The problem is that it is difficult, but not impossible, with current research approaches to inspire *radically* different devices, interaction styles, and novel views of our city and its inhabitants.

We argue for an approach that encourages a more divergent brainstorming style – explicitly away from the dominate research themes that continuously promote efficiency and productivity. Let us embrace the full scope of urban life with all of its emotions and experiences. This research investigation must begin before urban inhabitants acquire strong mental models and expectations from the current emerging suite of standardized urban applications. Finally, we encourage urban inhabitants to become proactive in the evolving and future design of our urban landscapes. In the spirit of cultural [17, 18] and technology probes [19] we propose a lightweight, provocative, inspirational research methodology for exploring computing in urban environments – *Urban Probes*.

URBAN PROBES

Recall that a probe is an instrument that allows measurement of an unknown – returning hopefully useful or interesting data. While probes can fail, their use is often used early on in fields where broad and rapid data is desired. Technology is emerging in urban landscapes where our complex social roles in urban communities, our movement and traces through cities, and our interactions with place and public artifacts intersect. We argue that these conditions are ideal for probes.

An Urban Probe is a fail-fast approach for asking early questions about urban computing in order to focus and influence future urban research and application choices. It is also a useful methodology for conducting rapid urban application discovery and evaluation metrics.

Urban Probes employ a series of lightweight provocative urban proto-tasks to inspire direct discussion from people about their current and emerging public urban landscape. These tasks involve physical construction of simple, functional artifacts and accouterments that are introduced into the urban landscape. These are not paper prototypes, but working models of potential systems. Contrary to traditional methodologies surrounding large scale research projects, each Urban Probe is designed to bypass many classical design approaches – opting instead for rapid, nimble, often intentional encroachments on urban places rather than following a series of typical design iteration cycles.

Urban Probes must capture provocative elements of urban computing questions while incorporating opportunities for play, Happenings [20], and various Situationists themes such as *détournement* (rerouting of events and images), and *dérive* (the urban flow of acts and encounters). Similarly, Urban Probes exploit methods of deep observation coupled with experimentation and concrete interventions in urbanism. In practice, Urban Probes develop and deploy novel physical artifacts into everyday urban settings.

Urban Probes draw large inspiration from the work of several leading researchers in developing technology probes and cultural probes [17-19]. Such probes combine the social science goal of collecting information about the use and the users of the technology in a real world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to imagine new kinds of technology to support their needs and desires.

Urban Probes complements these bodies of work by addressing similar themes with respect to urban life. As technology moves from office to home to street, we want to avoid bringing along with it "workplace" values such as efficiency and productivity at the expense of other possibilities. Urban Probes provide methods that aid researchers in gathering fragmentary glimpses into the rich texture of people's daily urban street life.

GOALS

The overall research goal of Urban Probes is to understand how our future fabric of digital and wireless computing will influence, disrupt, expand, and be integrated into the social patterns existent within our public urban landscapes.

While this is, admittedly, a lofty goal, the actually process of Urban Probing will almost certainly contribute in significant ways to the research space of urban computing. These probes will allow researches to collect inspirational data about urban place and people. They will provoke city inhabitants to think about the roles they play and pleasures they experience in urban places in their everyday life. The probes will hint that resulting urban technology designs might suggest new roles and new experiences of urban places. Finally, we hope that through its use, Urban Probes will develop as a methodology that can be used in further focusing urban computing research and influence future urban social computing technology directions.

THE URBAN PROBE METHODOLOGY

We will first outline the methodology followed by a step-by-step execution of an actual, completed Urban Probe exploring urban public trash called *Jetsam*.

Observation (Body Storming)

An Urban Probe begins with deep observations within a public urban space. Unlike brainstorming which is a traditional offline technique used to reflect on a researcher's observations of a task or activity, Urban Probes employ *in situ*, real time, in place brainstorming – or body storming [21]. Body storming consists of examining public spaces, its people, movement, and actions in extreme detail. By enforcing deep, extreme observation of a particular urban activity, object, or place, a more authentic understanding of its true role within urban life is revealed.

Some examples of questions to consider during such body storming activities are: What are the boundaries of this place? What is the "entrance" and "exit"? Describe the urban ecology of this place. What are the patterns within or across this space? Excavate or reveal the existence of at least one human trace within or across this place and interpret it. Expose a public secret that is concealed within this place. What one question would you ask this place? In this place, what is most "beautiful"? Most "disruptive"? What single word captures the aura of this place? In a single sentence, what is the meaning of this place?

Intervention

Traditionally, it is the observations that are used to directly influence a design or prototype to be tested. Breaking directly with this approach, Urban Probes explicitly encourage direct interventions into the authentic fabric of urban life. Just as an archeologist must excavate and alter a dig site to improve their view of the space, Urban Probes must directly intervene to alter and/or disrupt the usage, actions, or flow within the urban focus of attention.

Examples may include arranging public chairs in new patterns on city streets, placing flowers atop parking meters, chalking lines between the locations of discarded cigarettes, introducing new signs and billboards, or leaving and tracking "lost" cigarette lighters throughout the city [22].

While these actions may appear random and ill founded within the scope of urban computing, we argue that these physical interventions deepen a researcher's connection to urban objects, places and activities. In turn this accelerates the deconstruction and understanding of the essence of urban life, improves design outcomes, and promotes the emergence of fascinatingly novel ideas.

Artifact Production

An important aspect of Urban Probes is the creation of real semi-functional artifacts to introduce into an environment. Rather than designed to blend into the landscape, Urban Probe artifacts are designed to elicit direct reaction and promote immediate discussion about them. These objects or situations must be designed to answer or understand particular urban computing issues. Examples are objects that overtly address privacy, test strangers urge to collaborate, or expose an unknown or provocative element of a city landscape.

The resulting artifacts *must* employ some essential functionality. More importantly is declaring what these objects are not. They are *not* paper prototypes. They are *not* required to solve an explicit problem or improve a task. They do *not* need to meet industrial strength user testing requirements. In fact designs that are entirely impractical are equally encouraged. It is not the practicality of the artifact that manifests its merit. Instead the goal is to create such artifacts that will help unambiguously answer critical urban questions. This is precisely why objects that garner timid user reactions are less advantageous than those that provoke an immediate and polarized response.

With urban computing is in its infancy, Urban Probes encourages relaxation of the typical evaluation rigor of usability, engineering, and design. The goal is to use the probes to rapidly explore the research space and influence the overall direction of urban computing. Later, outside of the probing methodology, the necessary studies of usability, engineering, and design can be conducted.

Deployment and Reaction

The final stage of an Urban Probe is the actual introduction of the artifact into an urban landscape. The means of achieving this may vary depending on the probe. For example, it may be handing out 100 objects with RFID tags and a public kiosk reader, projecting images on a passing bus, or deploying several new wireless access points within a subway car. Observation is important at this stage in gauging the reaction and interaction of people and place with the new artifact. Questionnaires and surveys are encouraged to collect data of the deployment as well as other techniques such as video documentation.

AN ACTUAL URBAN PROBE – JETSAM

Urban life is largely composed of the movement, activities and familiar patterns of people within and across our crowded urban landscapes. There is also a curiosity, perhaps even verging on a voyeuristic interest in the lives of our fellow urban neighbors. As we traverse our city we share time and space with others. As we idle awaiting a bus, or navigate to our local café, we encounter other strangers. Often unconsciously we create fictitious stories about the lives of these people – that woman owns two cats, than man is a vegan, that child is lonely. These people and the way they dress and behave on public city streets provide us an insight into the lives of others.

Just as an archeologist excavates layers of debris from past civilizations to inform histories of ancient civilizations, so too can the discarded artifacts of today's urban inhabitants be used to create the rich milieu of everyday stories of urban life. In fact, we can observe these patterns by extracting the secondary traces that are left behind by the flows of urban inhabitants – the archaeology of public trash.

As urban places are traversed, used, experienced, and neglected, a pattern or trace of trash is created on the landscape. What does the type and/or amount of trash say about a place and the people that frequent (or neglect) it? Can new urban computing technologies influence trash accumulation, collection, awareness? Can we observe and interpret patterns of usage perhaps near a public city trashcan that can reveal a larger story of the place and people that inhabit and traverse it? We explore these and other questions using the Urban Probes methodology.

Archaeology of Public Urban Trash

The management and export of trash from urban centers has become big business, the last piece in a journey through conception, design, production, distribution, retail and consumption that finds focus in the city as a facilitator of commercial exchange and shear scale. Often ignored or regarded as disgusting, our urban trash reveals fascinatingly rich details of urban life. Archaeologists have long known that amazingly detailed images of life within an ancient civilization can be revealed by examining its trash. Trash is truth. While Americans report their "real" dietary patterns in surveys and interviews, the truth is actually revealed by examining the rubbish they leave behind. The Garbology Project [23] in the archaeology department at the University of Arizona has been measuring urban trends over the past 30 years by excavating and evaluating over 150 tons of trash across American cities. Our Urban Probe, *Jetsam*[1], explores urban public trash, its meaning, patterns, and usage, as it manifests itself in cities. Through this probe we hope to uncover new opportunities for technology to emerge across urban landscapes and further connect with our emotional experiences of living in cities.

[1] *Jetsam* comes from the nautical term that describes the cargo, odds, and ends that are thrown overboard and often wash ashore.

Trash and Technology

First introduced 30 years ago, the Universal Product Code (UPC) more commonly known as the barcode has become ubiquitous on product labeling and packaging and therefore on trash [24]. More recently, inexpensive RFID technologies, used primarily for inventory tracking during production and shipment, are poised to be incorporated into nearly every consumer product [25].[2] What opportunities arise as we examine such attached technology moving through the final stage of a product lifecycle – from product consumption to trash? RFID trashcan readers? Automated trash sorting? New visualizations of trash movement throughout a city? More importantly how will the heated public debate over RFID technologies and privacy play out in this space?

Our Urban Probe explores these themes and reveals the authentic life of a small urban microcosm centered around a small public artifact – a mundane, yet active public trashcan. This satisfies one of the previously discussed Urban Probes goals of exposing an unknown or provocative element of a city landscape.

OBSERVATION: TRASHCAN STALKING

Recall, each Urban Probe begins with a deep, *in situ*, observation by body storming an activity, object, or place of interest. The first probe step, observation, is designed to deconstruct the patterns of usage, traversal, value, and meaning of urban trash. Our primary goals were to:

- Reveal the patterns of usage and flows surrounding trash and trashcans in the city
- Challenge assumptions about the use of trashcans
- Gain qualitative insights into urban trash and its connection to everyday stories of people and place

Procedure

We chose a central trashcan in downtown San Francisco, located within a small public financial plaza near a local subway[3] exit and adjacent to the main downtown thoroughfare, Market Street (Figure 1). The trashcan sits within a space that is neither mundane nor a picture postcard scene. While the area contains tourists it is dominated by financial and urban workers as well as local city dwellers. The small plaza contains "integral seating" along a tree covered, low series of steps near the trashcan providing the necessary elements for a convivial small urban space outlined by Whyte [6]. It is the chosen daily lunch and rest spot for local city workers and many of the cycle messengers, giving it a dynamic atmosphere of everyday social activity. The location also captures many of

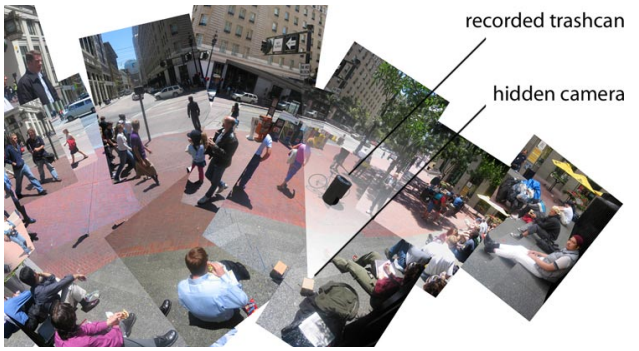

Figure 1: Panoramic view of our stalked trashcan

Lynch's five physical factors of the city that are integral in informing inhabitants "environmental image" giving it a strong identity, structure and meaning [7]. It is on the principal *edge* dividing the city north and south, as well as a dominant *path* for automobiles, public transport and pedestrian traffic, with wide sidewalks lined with commerce, cafes, shops, vending stalls, and bus stops. As a culmination of these many factors it is also inherently a strategic *node* for focused observation, and navigation. The geographical and social qualities of the plaza provide a perfect example of a dynamic, everyday city location for the study of an urban trashcan[4].

Using a small, fixed, concealed video camera we captured the scene immediately surrounding the trashcan (Figure 1). We also simultaneously logged the actions and atmosphere around the can. This included time stamped entries of the event type (items into trashcan, out of trashcan, or other), the object (description of trash) associated with the event, and the person involved with the event (gender, age, and other descriptive details observed). We also logged the approach and departure path for every individual that interacted with the trashcan in some way. This was later cross referenced to the video footage to compile a complete picture of the role that this trashcan plays in the everyday drama surrounding it (Figure 2).

In total, three trashcan stalking exercises were performed. The first was simply a dry run with little formal data collected. The two subsequent full observations were conducted at different times. Stalking 2 was performed in the evening for nearly an hour and a half beginning at 6:30pm. The final stalking, Stalking 3, was for slightly over an hour and a half beginning at 1:15pm in the afternoon. All three stalkings were performed in the warmer summer months of rather seasonal weather in California. For example clear skies and warm (23°C) temperatures coincided with the afternoon stalking, Stalking 3.

[2] The most ubiquitous American retail outlet, Wal-Mart as well as the largest distribution entity in the United States, the Department of Defense, have both mandated RFID compliance within the next few years.

[3] The subway is part of the Bay Area Rapid Transit system or BART – an above and below ground commuter light rail system.

[4] Previous interviews with city planners of recently renovated plazas within San Francisco had revealed that in landscape design there are no formal methods for planning trashcan placement. The required number and positioning of trashcans is anticipated with common sense and experience, generally at "bottleneck" locations of high flow and nearby to seating.

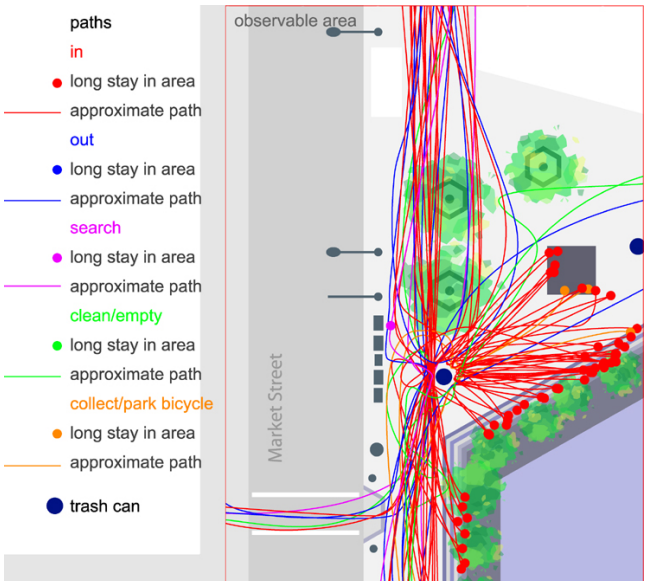

Figure 2: Diagram of the paths taken before, during and after interaction with the trashcan – Stalk 3 - 1:14pm to 2:41pm

Results

Focusing on Stalking 3, we observed 65 individual interactions with the trashcan over the one and a half hour period. On average, the can was "used" every 80 seconds with a maximum of 6 minutes and minimum of 5 seconds between interactions. Of the 65 interactions, 47 individuals were one time users while 8 interacted more than once with the trashcan during the stalking.

Even within this highly focused view of a single urban trashcan, the data was highly revealing and vivid. We were able to extract many insights into the interrelationship between people, place, actions and trash. Plotting the paths taken by the people that interacted with the trashcan revealed that many of them stayed in the immediate area for several minutes or more, either before or after using the can (Figure 2) – a total of 54% across both observations, 34% of the 18 interactions in Stalking 2 and 60% of the 65 interactions in Stalking 3. Informal interviews in the plaza supported the conclusion that a high proportion of people who use this trashcan spend a considerable amount of time in the plaza as part of their daily routine.

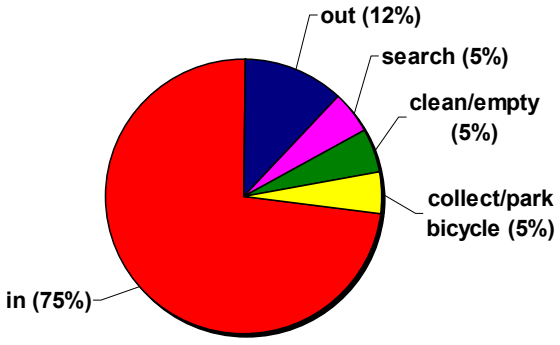

Figure 3: Breakdown of the 65 total trashcan interactions observed in Trashcan Stalking 3

Regular interactions with the trashcan included trash going in, scavengers searching within it, scavenged items being remove, bikes being parked and collected from the trashcan (an impromptu bike stand), and the trashcan being cleaned or emptied. Surprising less than 75% of the trashcan interactions involved actually discarding trash. Over a quarter (33% in Stalking 2 and 27% in Stalking 3) of the trashcan's use was composed of other interactions such as searching in, removing from, and cleaning the trashcan (Figure 3).

The trashcan was also revealed as a point of exchange. Items of value such as food, recyclables, and re-usable objects such as shoes were removed within minutes of being thrown away. Interestingly, scavengers that searched for food never took recycling and vice versa. On occasion a single bottle of Sprite soda was first observed being dropped vertically into the can, almost full, only minutes later to be picked out, finished and thrown back. The bottle resurfaced only a few minutes later in the same stalking as it was collected for recycling by a third individual. Similar patterns of exchange were observed by Whyte who conducted a short study of trashcans in Manhattan in the 1970s [26]. In this study Whyte commented that such regular trashcan scavenging actually provided regular upkeep by compressing trash and hence preventing garbage overflow. San Francisco's exceptional recycling rate (63%) is supported in a small degree by those that sort through city trashcans. As with the city workers on lunch time breaks, scavengers were also regular visitors to the plaza. We observed scavengers often walking cyclical routes that took them back to the same can more than once.

The contents of the trashcan were rarely surprising, a vast majority of items were food related, primarily the packaging from nearby cafés, coffee stands and fast food restaurants. Other common items included newspapers, magazines, cigarette butts, boxes, and plastic bags. It's important to note that the seemingly large volume of trash collected in public containers accounts for only a small percentage of the total trash of a city. By far the largest portion of urban trash is composed of domestic and construction waste [23] which were intentionally excluded from our study. The lack of unusual items reflects both common habits and the business of the plaza as opposed to the type of trash found in other separately located trashcans.

Our conclusion for this step of the Urban Probe is that the type and amount of trash deposited into a public trashcan reveals a story of the local ebb and flow of the space, chronicles the daily rhythms of a place and time, and hints at the identity and presence of city inhabitants. This insight is full of qualitative stories, like observing young men repeatedly using a trashcan for target practice or the tools and techniques used to fish recycling from within the can. It suggests both a wider picture of place and social ecology. It paints as intriguing stories of authentic life within the mass of the city – stories inspired by curiosity and drawn out by imagination.

INTERVENTION: LOST POSTCARD TECHNIQUE

Our intervention step of the Urban Probe involved strategically placing our own "trash" or traces of people across the city. To understand the individual level of curiously in accidentally discarded traces of fellow city inhabitants, we adapted Milgram's "Lost Letter Technique" [8] into a new methodology we call the "Lost Postcard Technique". Milgram's original study involved dropping hundreds of seemingly lost letters (addressed and stamped) in different neighborhoods. The letters were addressed to political and often extremist groups. By examining the proportion of returned letters (*i.e.* those forwarded on by individuals that happened across them within the city), he was able to assess public opinion concerning issues associated with the groups the letters were addressed to. Rather than actively soliciting direct answers from individuals, this technique allows anonymous urban group behaviors and attitudes to be measured passively by tallying the ratio of returned letters across several variables.

Our goals for the Lost Postcard Technique were:

- To what degree are people interested in traces left by others? Will the items create narratives?
- What interpretations of value do city dwellers place in the detritus found within the street?
- Will found items be viewed as lost or trash? And will people take responsibility for this "lost trash"?
- Will the levels of interest, responsibility and curiosity vary depending on the location, and context, and personal nature of the lost item?

Procedure

To reduce our chances of being observed, at 5:30am we began dropping 110 hand-written, addressed, and stamped postcards on the streets of central San Francisco. The cards were distributed as evenly as possible across a wide area of the central city (Figure 6). The cards were divided into three categories distributed in equal proportions and designed to be decreasingly personal, in content and intended audience – card types A, B and C (Figure 4).

Type	Overall Theme	Card Image	Card Text
A	*Personal* individual to individual	personal photograph	illicit rooftop antics
B	*Semi-personal* individual to informal group of colleagues	humorous postcard	office party thank you
C	*Semi-public* individual to community	boating trip flyer	advertise community trip

Figure 4: Table of Lost Trash postcard categories

All the cards contained a short message discussing a recent event shared between sender and recipient, each ending with a unique URL which contained a link to online images from the fictions event. For example, the personal cards (Type A) were each handwritten with the text:

Robin,

Got this picture back and thought of you. What a blast last week! I still can't believe we didn't get caught sneaking onto that roof. Keep these pictures to yourself.

www.sfnetworks.org/chris/rooftop/83_241.htm - Chris

The URL provided the opportunity for deeper investigation into the card's content, a secondary level of recordable action that would further reveal levels of curiosity. Each of the 110 URLs had a different numerical code; these codes were used to log the time, location and context of the dropped cards. This allowed us to track the specific actions taken for each card in one of four expected outcomes:

- no recordable action – card either disregard as trash or picked up and disposed/ignored
- card picked up and returned via mail
- card picked up and URL visited
- card picked up, URL visited, and returned via mail

The cards were also placed in a 5 different types of context: (1) on the street and (2) on raised surfaces such as benches (Figure 5), steps, window sills, newspaper boxes and on top of trashcans. They were also placed in far smaller proportions on (3) car windshields, (4) bike or moped baskets to sample what reaction there would be to cards found on private property within public space, and lastly (5) on public transportation such as BART and cable cars within the city.

Figure 5: Typical postcard placed "on surface"

Results

Within 3 days, we had received nearly 49 of the postcards (45%) in the postal mail – forwarded on by individuals. Exceptional cards went on long journeys from a bench in a Chinatown park to Reno, Nevada, from where it was returned 19 days later. The proportion of returned cards across the 3 categories was fairly consistent, as were the results across the 5 contexts. It soon became apparent that the quality of the study would lie in the richer actions and stories attached to the minority of the found cards.

We received 4 cards with added messages, something we had not anticipated. Two of these "message" cards noted that the card had been found – one with contact details.

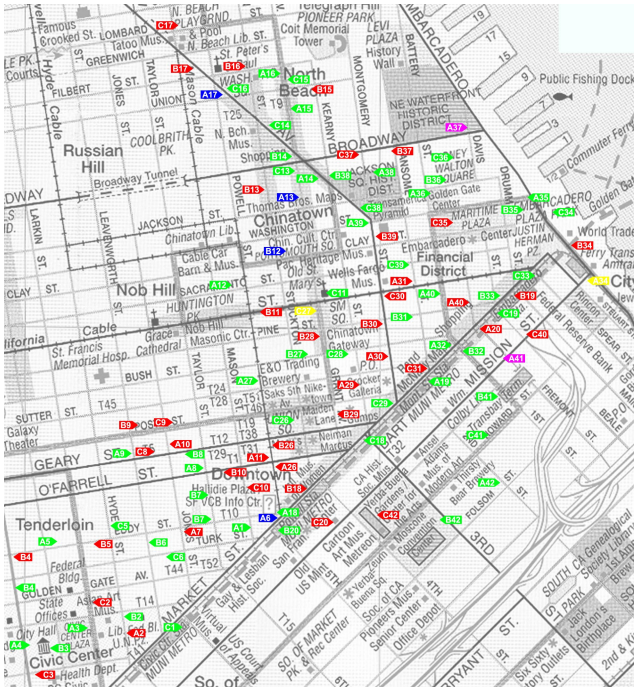

Figure 6: Map of all dropped postcards colored by action

The fourth card which was a personal rooftop card (Type A) left on a concrete bench on Columbus Avenue in North Beach at 8:53am was returned with the added message:

> *Actually, we have video footage of you sneaking around, we turned them over to Tom Ridge. Vote Kerry!*

There were only four URLs hits in total. Three were an investigation of the story contained in the personal cards; one of these cards was kept for six days until the URL was hit and a further three days before the card was finally returned. Two of the URL card hits were never returned via mail. Although it is hard to draw clear quantifiable relationships from our results, it would be fair to assume that a sizable section of urbanites (reflected in this study) are inspired into curiosity and more explicit action by more personal traces left by others in the urban spaces they share – while the majority may have passed by the lost cards as just another piece of trash within the city.

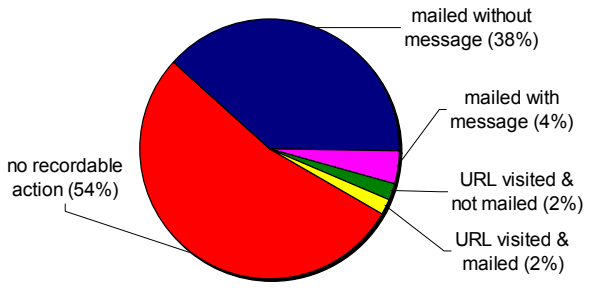

Figure 7: Breakdown of actions taken for all 110 postcards

INTERVIEWS

We also conducted interviews with city planers, waste managements companies, architects, trash workers, and city inhabitants. The comments from the first four have been incorporated across various sections of the paper. In this section we focus on the individual interviews with everyday city dwellers.

Individuals were approached on the city streets during afternoon business hours and asked a short list of questions about city trash and their interactions with public trashcans. The 15 individuals (10 male/ 5 female) covered a broad age range [(1/15) – 20s (3/15) – 30s (5/15) – 40s (3/15) – 50s (1/15) – 60s (2/15)] and were overwhelming (14/15) local residents to the city or daily commuters from surrounding areas. Many of them visited the area of the interview (predominantly Union Square, the plaza at Montgomery BART, and the Embarcadero) daily and often used the same trashcans in that particular place on a regular or daily basis (9/15 confirmed this explicitly). Most of them said they used a public trashcan regularly – from 4 to 40 times a week. The majority used a public trashcan at least once a day. Individuals were also shown flashcard images of purposefully cheap objects in various contexts that sit in a grey area of personal value: old shoes on trash can, a toy left at the edge of a sidewalk, a magazine shoved in a chain linked fence, and a personal picture CD-ROM next to a bus stop bench. They were asked to comment if each item was trash or not and to describe who left the object behind, and why. We encouraged each individual to describe their feelings towards trash and its connection to place and people.

Overall the outcome was evenly split between people who categorized the items trash or not trash. Of the items listed as not trash, the toy and image CD-ROM had the most perceived value ("lost"), then the shoes ("left for others" or "left for homeless"), followed by the magazine that people generally thought of as "litter" left by an inconsiderate person "probably young". A large majority (11/15) gave explicit descriptions of who lost or left the object there and why. Many of them explained that they would investigate the object further if they found it – from "taking a closer look" to "picking it up and taking it home".

The comments about trash gave a clear indication of how individuals related to their urban rubbish. A few took the discussion of trash and the city to a political conclusion discussing the issues of environment, consumerism and consumption – reflecting San Francisco's liberal politics. Many of the people thought of city trash as telling a story as reflected in this quote by one individual:

> *"The objects that other people throw behind have more value than new objects, you know, they've traveled around with different people, they have a story. That's what gives antiques there value."*

ARTIFACT PRODUCTION: AUGMENTED TRASHCAN

We employ the results from the prior steps of the Urban Probes methodology to directly influence the design of a functional urban artifact. Our Trashcan Stalkings (Observation) revealed that a seemingly banal part of the urban infrastructure is actually a focus of rich human activity, a microcosm of social ecology. The urban computing question is:

> *How can digital technologies reinterpret this social and physical archeology, the presence and traversal of people and artifacts, and expose patterns of urban life?*

The Lost Postcard Technique (Intervention) exposed an active curiosity towards discarded and/or lost objects and the people that once owned them. The question is:

> *What representations and potential interactions with discarded human traces will intrigue, excite, disgust, and inspire urban dwellers into a new awareness and participation in this part of the city's physicality and their daily lives?*

Finally, our interviews revealed that most people not only create vivid stories about trash and lost objects left throughout a city but also manifest a voyeuristic curiosity about the people that discarded such objects. The question:

> *How can technology embedded within the city's infrastructure facilitate and provoke story telling?*

Architecture

Inspired by the preceding results and questions, we constructed a fully functional augmented trashcan (Figures 8 and 9). The augmented can exposes city dwellers to the pattern of trash interactions as told from the point of view of a single city trashcan. Two event types can be sensed: interaction events and trash in/out events (including the type of trash involved). We used a simple IR photoelectrical switch to detect a basic interaction with the trashcan such as searching. A sensitive electronic scale determines the current weight of trash entering or leaving the bin. Mounted within the trashcan, an overhead camera records the top layer of trash in the bin. A laptop computer connects the devices and projects an appropriate visualization from the trashcan's opening onto the city street.

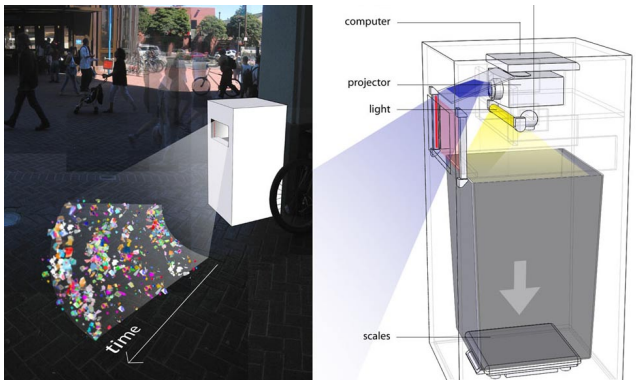

Figure 8: Architecture of Augmented Trashcan

Experience

There are several methods of interaction with the augmented trashcan: *active*, *passive*, and *mobile*.

Tossing trash into or removing trash from the augmented trashcan is an *active* interaction. For example, after finishing her lunch while sitting on a nearby bench, Jill tosses her bag of trash away. The augmented trashcan detects the event as the item enters the bin. Using the camera and digital scale, information about the new trash is logged. Its weight is measured and a rough image of the trash is extracted by subtracting out the previous image of the top of the trash from the current. The isolated image of the trash, its time, and weight are all logged. After a short time, an image of the individual item is introduced into the animated, projected visualization.

Any individual passing near the augmented trashcan interacts *passively* with it by observing its shifting visualization. Mounted inside the trashcan, a projector renders a view of the recent activity of the trashcan over time. Recall that an image of each piece of trash is captured by an overhead internal camera. This image is incorporated into a continuously projected visualization on the ground in front of the trashcan. Recent items appear closer to the base of the trashcan and slowly "orbit" outward over time. Each trash image also rotates on its axis based on its weight with heavy items spinning slowly and light items more quickly. When the system fails to isolate an item in trashcan image after an event, either because the image difference is too large (*i.e.* the trash fell over) or too small, an iconic representation of these events is substituted into the visualization. As time elapses, the orbiting "trash images" slowly progress outward, away from the trashcan eventually disappearing completely. The resulting visualization depicts a layering of trashcan activities and patterns, not unlike the archeological layers typically found during years of drought or catastrophic change. Will the lunch trash layer reveal itself? People passing nearby will be able to glance at the augmented trashcan's visualization, noticing a familiar or unusual ebb and flow of trash within a local area of the city. The completed and fully functional augmented trashcan in action can be seen in Figure 9.

Figure 9: Completed and deployed Augmented Trashcan

Envisioned Scenarios

A few very simple envisioned scenarios: Spike in subway tickets – people have recently arrived her from elsewhere; large quantities of burger containers – nearby fast food restaurant appears popular; unusually few Starbucks cups – people are frequenting another nearby café; more blue lottery tickets than yesterday – nearby people are risk takers, dreamers, or foolish; a green plastic doll – why did this boy or girl discard that and what are they like?

Mobile Experience

We also envision several possible *mobile* phone interactions with the augmented trashcan. One such simple interaction allows an individual to send an SMS text message to the trashcan. The actual sent text, perhaps a comment on a piece of trash in the visualization, can be integrated into the visualization as a form of street trash poetry. Secondly, such users are "rewarded" for active participation by being send back a higher resolution image of a recent piece of trash or interesting statistics.

Realistically, we have no grand visions of people documenting and obsessively checking on their local augmented trashcan and its contents with their mobile phone. After all who wants trash messages sent to them? However, we do believe that such a device can enable visualizations of patterns, flows, and prompt further reflection on urban trash, its value, and usage. Even a limited form of the mobile phone interaction may spawn individuals to create fanciful urban stories and improved views of their city.

CONCLUSION

The very essence of place and community are being redefined by personal wireless digital tools and mobile devices that transcend traditional physical constrains of time and space. New metaphors for visualizing, interacting, and interpreting the real-time ebb and flow of urban spaces are certain to emerge. Without a concerted effort to develop a deeper understanding of the implications of emerging technologies on our urban landscape, computer and social scientists, city planners, architects, and others run the risk of losing touch with the reality of our urban streets and their inhabitants. Urban Probes provides a new research methodology for exploring, deconstructing, and understanding our urban landscapes as well as empowering city dwellers to participate in the construction of their newly emerging digital city landscape.

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