The Social Fashioning of Emerging Communications Infrastructures

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ABSTRACT
This paper looks at the changing dynamics of the networked experience as new communications infrastructures emerge to support a network body whose disembodied presence is grounded in the necessity of the material. Unlike fixed networks, spontaneous ad-hoc networks rely upon mobile and flexible infrastructure which can dynamically reconfigure based on necessity and circumstance. As these communication devices are integrated into intimate personal objects, into accessories and clothing, the statement that "the people are the network" becomes increasingly resonant. Within our research group several projects have sought to examine the social infrastructure of transitory ad-hoc networks. This paper presents some of the work developed towards socially fashioning networks, using clothing and accessories as the departure point for exploring the relationships between individuals, artifacts, and the networked entity they comprise. The projects deliberately explore fashion as articles to be worn or carried and how existing understandings of an object's use and function feed into the experience and interaction of a networked system. The capabilities for these garments to connect, respond, or 'remember and forget' give new meaning to the identity of the wearer. The understandings gleaned from these works provide insight into future conceptions of the self and one's relationship to others, in addition to a more profound understanding of interpersonal and symbolic negotiation within shared 'space'.

KEYWORDS
Fashion, Interaction Design, Networks, Wearables, Public Space

1. INTRODUCTION
In the early days of the Internet the dematerialization of place allowed for the development of a digitally embodied aesthetic, where "virtual" equivalents of physical objects were believed to be capable of replacing their material counterparts. The physical world, with its spatial and temporal limitations fell out of vogue, unable to compete with the chimerical seduction of the electronic agora (1). However, as ubiquitous computing technologies have emerged in the "third wave" (2) of the digital revolution, the importance of the physical and the local has acquired renewed relevance as emerging technologies are increasingly incorporated into the everyday environment. New communications infrastructures stress decentralized and temporary networks, which support mobile and distributed computing needs. More importantly, these emerging network communications technologies have the capability to reinforce and supplement existing social and behavioral structures allowing for deeper resonances between the "virtual" and "physical". This paper will present examples of *socially fashioned networks*, or networks which use social behavior and human mobility as the means for establishing a network infrastructure between co-located individuals. The various projects discussed represent social fashioning at different degrees of behavioral and technical resolution. They function as lenses through which spatial-temporal constraints are focused and applied in order to create interrogative disruptions in everyday experience. Through this process

Katherine Moriwaki and Linda Doyle,
The Social Fashioning of Emerging Communications Infrastructures,
presented at **CiberArt Bilbao**, Bilbao, Spain, 25 - 29 April 2004.

individual and group relationships in public and urban space are challenged and re-imagined using everyday objects and activities.

2. SOCIAL FASHIONING AND NETWORK INFRASTRUCTURE

In 1995 Negroponte announced the end of geographical limitation in the post-information age (3). The promise was, through working with digital information, individuals could connect, and communicate anytime and anywhere, irrespective of geographical location. From the telegraph to the internet, new communications technology has provided a third space for interaction, linking people from across the globe, cutting across national and cultural borders. While such technologies have undoubtedly brought their advantages, speeding the pace and reach of human interaction, the specific opportunities created through situated proximity were often left unexplored by early evangelists of the medium. Meanwhile insights into the resonances and discrepancies between virtual and physical space led to a greater understanding of the ability of online forms of interaction to provoke new types of social presentation and behavior, often spilling over into "real" life. This relationship between the virtual and the physical, when moved beyond the simplistic paradigm of substitution (with information space replacing physical space) provided the groundwork for recent developments in mobile and ubiquitous computing and embodied interaction.(4) Through starting with the assertion that social beings are the basic unit of design (5) everyday activity in the physical world becomes the idealized setting for digital technologies coupled with spatially situated interaction and locally relevant information. Like the minutiae of non-verbal exchange invested in simple acts, digital media has developed conventions for both near and remote interaction. Researchers in Computer Supported Cooperative Work (CSCW) have looked extensively into augmentation of face to face and distance communication between individuals (6), but have so far looked less at how new conceptions of social and psychological constructions of space are developed, and more at assisting workflow or business meetings. However, while work plays an important role in most people's lives, it is not the sole focus, and a good deal of people's lived experience is oriented not towards supporting work, but subverting it. It is in this spirit that interactions, in physical space and augmented through digital technologies provide a window for viewing new relationships between individuals and others.

In the process of socially fashioning the works presented, situated experience in urban space and subversive uses of disruption and constraints provide the environment in which to provoke social interaction and awareness. Through changes in the material and metaphoric significance of existing everyday artifacts, and the augmentation of accepted behavior and use of these objects, a greater individual and group awareness can emerge. The projects presented all use common accessories as garments as their interface, capitalizing on the notion of fashion as a "second skin" and "final layer". (7) Each presents a return to situated interaction, where boundary conditions surrounding everyday performative actions are "made strange" and transitory or ad-hoc connections to socially formed networks are promoted. Each project functions at a distinct degree of social and technological resolution, providing illustrative case studies of different communicative infrastructures.

3. RECOIL

"*RECOIL*" is a set of garments (Fig. 1) which contain small yet very strong embedded magnets which attract and attach to other people and objects in the cityscape without the wearer's permission.


(Fig. 1) *"RECOIL" garments*

The project addresses the social infrastructure of high density urban spaces, and the effects of overcrowding and public anxiety. Due to the attractive force of the magnets embedded into the clothes, "*RECOIL*" garments attach themselves to other people and objects in the environment (through latching onto another person's metal belt, or a turnstile, for example.) The wearer of the garments are unable to control what the clothing attaches to, and often do not know what elements in the environment will be magnetically attractive, creating an environment where an everyday stroll through familiar streets in the city can become a strange and awkwardly playful experience. Within crowded urban conditions, as the proximity to others increases, the likelihood of unexpected, unwanted, and sometimes inappropriate physical contact rises. Both Canetti (8) and Hall (9) point to the aversion individuals have to unwanted and accidental touching by strangers. When physical space is scarce, psychological barriers are erected to compensate. This desire to demarcate territory is highlighted by the "Hertzian Space" (10) identified by Anthony Dunne, which is saturated with the emissions of electronic devices and encroaches upon human psychological space through neuroses and irrational fear of the invisible spectrum. "*RECOIL*" was a way of drawing individuals out beyond their social and physical comfort zone, while at the same time investigating possible ad-hoc peer-to-peer physical re-configurations of the body which could create changes in the subjective experience of the individual and group. While using no digital technologies, "*RECOIL*" presents a novel way in which to think about socially fashioning a network. By creating disruptive breaks in the wearer's everyday experience through clothing, "*RECOIL*" challenges ordinary means of social, psychological, and physical spatial navigation. The project could easily be extrapolated to include digital communications devices, and future work in this area is planned.

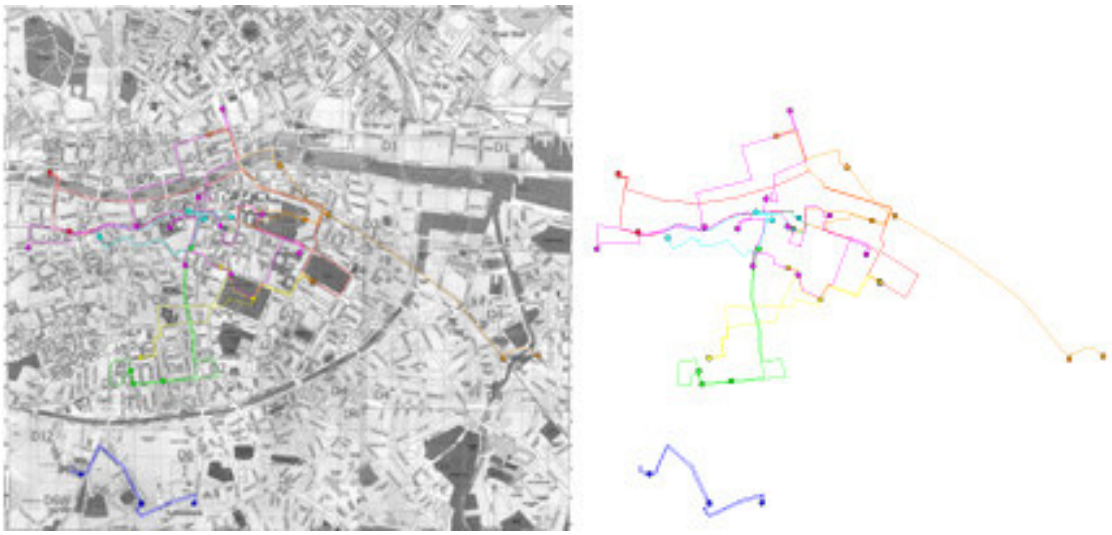
4. INSIDE/OUTSIDE

Like "*RECOIL*", the next project, "*Inside/Outside*" looks at ad-hoc peer-to-peer connections, but rather than creating involuntary connections between individuals, "*Inside/Outside*" encourages the exchange of information.

(Fig. 2) *"Inside/Outside" bags*

"*Inside/Outside*" is a set of handbags (Fig. 2) that monitor environmental irritants and share maps of individual pollution levels based on physical co-location. An "*Inside/Outside*" bag monitors ambient air quality or noise pollution levels and displays the data along two axes. The first is an ambient display which acts as a "mirror", reflecting real-time exposure levels. The second is a data "diary" which stores environmental exposure levels over time. The data can then be reviewed at a later date through mapping visualizations. The bags are equipped with 802.11b wireless communications, and when in radio range of each other, form a network and swap environmental data, creating *necessarily incomplete* maps of the city's pollution. The size and reach of the map depends on the number of individuals the wearer has passed throughout the day. (Fig. 3)The emergent diagrams are locally specific and contextually relevant views of pollution information in the city, one that is coupled tightly with the movements of each bag wearer, and others who cross their path. (11)

The bags were designed as means of creating personally invested information access, using data that is not commonly available to regular individuals at the granular level, and allowing information exchange based on situated co-location. Through instrumented use of an everyday object (the handbag) external information (environmental irritants) would be integrated into the awareness of an individual, resulting in an expanded mental map of the city. In aggregate the information collected by multiple individuals in the city could be used by the inhabitants of a community to police and monitor their own neighborhoods and public spaces. By introducing an augmented everyday object into the social infrastructure of people's everyday lives, personal expression, function, and wireless communications form a socially fashioned network, utilizing "local knowledge" and connection with the environment. "*Inside/Outside*" provides alternative views of the city and urban life, through connecting unseen social networks (that of shared urban space between individuals) embedded in daily activities. As a succession of new connections are temporarily made, the system retains the data "snapshot", building on the forgetfulness of the "*RECOIL*" garment, and instead filing away each instance of data sharing. Rather than altering the bodily configuration of the wearer, "*Inside/Outside*" creates reflective displays of impact, allowing the bag to serve as proxy for the physicality of the individual.


(Fig. 3) *Collaborative Mappings*

5. CIRCUMSTANTIAL NETWORKS

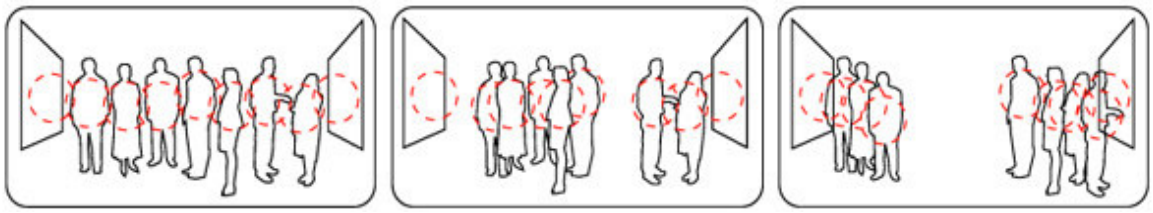
Whereas "*RECOIL*" and "*Inside/Outside*" examined ad-hoc peer-to-peer relationships, the following projects, "*Oscillating Windows*" and "*Umbrella.net*" interrogate multi-hop ad-hoc networks (MANETs). MANETs are typically described as temporary associations of mobile nodes, which do not depend upon fixed support infrastructure. (12) As a result such networks are non-hierarchical, distributed, and dependent on the proximity and cooperation of other nodes. In the previous projects, ad-hoc *connections* were used to swap data and create physical bodily configurations. "*Oscillating Windows*" and "*Umbrella.net*" use mobile ad-hoc networks as the infrastructure for socially fashioned networks.

The network topology of an ad-hoc network may change rapidly and unpredictably according to available resources and shifting infrastructure requirements. Though typically reliant on wireless radio communication, the organizing principles (decentralization of control, re-configurability, mobility, and physical proximity) of ad-hoc networks are their distinguishing characteristics rather than the physical method of transmission. It is these organizing principles, which provide compelling corollaries to the physical world of movement and social relations, as wireless radio signal range mimics the territorial spatial rings (9) surrounding the body, first demarcating space through wireless signal propagation, then integrating a constantly changing and complex configuration of mobile nodes into a network body. This tightly coupled relationship between the topology and behavior of social and ad-hoc network infrastructures creates a rich area of emerging exploration where wireless and social networks are interleaved.

6. OSCILLATING WINDOWS

The project "*Oscillating Windows*" presents an application for close-proximity network communication where physical co-location, proximity, and group interaction move a digital image to and from opposite sides of a space. Through short-range ad-hoc wireless communications worn on individuals a signal is passed through a crowd from one person to another. By introducing consequential rewards (the changing of the visual properties of the environment) the project attempts to influence and change the social behavior of individuals in groups. Based on the number

of people and their physical proximity and orientation, the ad-hoc network forms and allows the transmission of data.



(Fig. 4) Critical mass determines the data pathway

Without a critical mass of people in the space the digital image in the "*Oscillating Windows*" application cannot move locations, but as critical mass is reached a pathway for the data is created, and bits begin to flow. Likewise, if critical mass cannot be achieved or there is an uneven distribution of people within the space, there is no data pathway, and data transmission does not occur. (Fig. 4) The existence of the network is entirely dependent on the individuals and whether or not they organize around particular configurations. Typically this has been seen as a weakness of ad-hoc networks as it means communication between network nodes is not always possible; however, this "weakness" has been leveraged into the design and implementation of the project into a feature of the application. The goal is not to maintain a continuous network, but to see how changes wrought in the environment as the result of aggregate human presence and the presence of the network might create greater awareness amongst individuals in a co-located environment. Over time perhaps repeated visitors to a place running "*Oscillating Windows*" may slowly realize their actions and behaviors change the environment. Certain behavior or actions may be "learned" in order to produce particular environmental effects, or serve as an ambient indicator of the activity and movement of crowds. Unlike "*RECOIL*" or "*Inside/Outside*", the ad-hoc network links entire groups of people together in a chain of connections which make their impact not only on the individual, but also on the environment. The changing perceptual elements of the space, which depend on the proximity and presence of individuals is an example of a circumstantial network, where specific conditions must be met before the network can instantiate. When such networks require enforced cooperation, a new type of social play might form. "*Oscillating Windows*" indicates how ad-hoc networking may lead to new questions as to how to indicate network presence and activity..

6. UMBRELLA.NET

Similarly, "*Umbrella.net*" takes circumstantial action and co-location to form a network which acts as a *visual footprint* of network activity in a public space. The project consists of a wireless ad-hoc network which is deployed when multiple people individually open their umbrellas in the rain. The reach of the network grows and shrinks proportionally to the number of people who have opened or closed their umbrellas. Contained in each umbrella is a wireless communication device, which initiates the network. (Fig. 5)

(Fig. 5) *"Umbrella.net"*

In the same way that "*Inside/Outside*" used a handbag to deploy a wireless network, "*Umbrella.net*" uses another everyday object, the umbrella, as the starting point for a socially fashioned network. The "*Umbrella.net*" system works with a hardware and software component that is integrated into the object (an umbrella) without damaging its original use value. The umbrella still works in the way it normally does, yet has additional functionality. The prototype includes a handheld PocketPC (iPaq) computer that interfaces to the umbrella and only communicates with the other umbrella devices when the need exists: i.e. when rain is present and other nodes exist in close proximity. When the umbrella is closed the device is off. When the umbrella is open, the device engages and begins looking for other wireless nodes. To visualize the network to passerby, the umbrella illuminates in a pulsing red pattern to indicate that it is not connected to, but looking for the ad-hoc network, and turns blue when the network has been found. The software (Fig. 6) includes a chat messaging application allows fellow umbrella users to communicate with each other, and see how many hops (nodes) they are away from each other. A "sociability" range is provided which determines from how many hops away users can to receive messages. "Umbrella.net" creates a *visual footprint* of network activity, similar in effect of the visual sync of blinking of fireflies.(13)

(Fig. 6) *"Umbrella.net" software*

In terms of social fashioning, the "*Umbrella.net*" project takes its inspiration from the contextually specific environment of the crowded city street, where small individual actions have larger aggregate results. The condition of being caught in the rain in a public place is something which cuts across social and economic lines, as well as various goals and intent. Street vendors, tourists, and pickpockets all occupy the same public space with very different purposes, and for varying amounts of time. These diverse renderings of time and activity can be caught in a "point of intersection" between flows, highlighting emergent coordination in a polyrhythmic (14) society. Like "*Oscillating Windows*," "*Umbrella.net*" is a circumstantial network which requires specific conditions to be met in order to exist. However, instead of using the environment to visualize network presence and activity, "*Umbrella.net*" uses the people that make up the network to display its *visual footprint*. The effect is a poetic disruption, borne of the apprehension of sudden, striking, and unexpected connections between people in public space. As with all previous projects presented, "*Umbrella.net*" is driven by proximity and co-location, but also highlights a point of intersection between urban flows, harnessing individual yet coincidental action into an aggregate and social phenomenon.

CONCLUSION

This paper has presented examples of *socially fashioned* networks which operate along varied technical and behavioral axes. While "*RECOIL*" and "*Inside/Outside*" examine ad-hoc connections, "*Oscillating Windows*" and "*Umbrella.net"* interrogate mobile ad-hoc networks.

"*RECOIL*" takes a "no-tech" approach to ad-hoc behavior, using physical constraint and social anxiety to disrupt boundaries between strangers and the environment, whereas "*Inside/Outside*" creates enlarged mental models for its users, by developing new relationships between the individual and the environment. Rather than sensing the environment, "*Oscillating Windows*" enforces cooperation amongst users in order to produce changes in a public space, and "*Umbrella.net*" creates a visual footprint of a wireless ad-hoc network. All of the projects discussed take the urban condition as the prime environment for application deployment, and re-imagine relationships between the individual and the group in ways that utilize common interfaces and everyday objects. By focusing on everyday objects which are worn or carried each of these projects generates a performative duality between actual and observed use, allowing clothing and accessories to direct social interaction and self-expression.. Through exploiting perceived technical weaknesses as strengths, as well as anticipating and embracing disruption and subversive use, "*RECOIL*," "*Inside/Outside*," "*Oscillating Windows*" and "*Umbrella.net*" provoke discussion regarding the appropriate use of technology in public space, and raise opportunities for beautiful, poetic, and disruptive interrogations of urban life.

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Author Biographies

Katherine Moriwaki is an artist and researcher investigating wearables, fashion, and the experiential resonance of technologically mediated urban public space. Currently a Ph.D. Candidate at the University of Dublin, Trinity College, her work has appeared in IEEE Spectrum Magazine, and has appeared in numerous festivals and conferences including Siggraph (2000), numer.02 at Centre Georges Pompidou (2002), Break 2.2 (2003), Ubicomp (2003), e-culture fair (2003), Transmediale (2004), and CHI (2004). She is a 2004 recipient of the Araneum prize from the Spanish Ministry for Science and Technology and Fundación ARCO.

Linda Doyle is a Lecturer in the Department of Electronic and Electrical Engineering. Her research group is the Networks & Telecommunications Research Group, (NTRG), and is based in the Department of Electronic & Electrical Engineering and the Computer Science Department in Trinity College Dublin, Ireland. The NTRG focuses on core networking technologies, telecommunications services, and e-commerce and network security. Linda's particular research is based on wireless communication systems with both a technical and artistic side. She has written and co-authored many research papers on 4G communication systems, reconfigurable radio systems, and ad hoc networks.