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Immanent Domain

Pervasive Computing and the Public Realm

A wave of emergent digital technology holds vast implications for the public sphere. Indeed, these new forms of mobile and ubiquitous systems, called *pervasive computing*, challenge some of our fundamental ideas about subjectivity, visibility, space, and the distinction between public and private. Together, these challenges reformulate our conception of the civic realm. From cell phones to wireless local area networks, smart buildings to embedded vehicular computers, an invisible web of digital technology already lies across the visible world creating new space for work, data, advertisement, investigation, communication, intimacy, and danger. This generation of computers is so well integrated with the environment that it will be difficult to distinguish between the two, which represents a profound transformation for everyday life.

Machines that fit the human environment instead of forcing humans to enter theirs will make using a computer as refreshing as taking a walk in the woods.

Mark Weiser

Introduction

In 1991, the late Mark Weiser wrote a prescient essay for *Scientific American* foretelling the age of ubiquitous computing that he described as "embodied virtuality," in contrast to then cutting edge virtual reality. It is this very distinction that motivates the present essay. For architects and urbanists, there can be no more significant revolution in digital technology than the spatial embodiment of computers embedded everywhere.

This essay makes the argument that, although embodied virtuality has emerged from clear historic precedent and origins, it raises four distinct implications that hold the potential to change our ideas about space and spatial practices. First, our environment is enacted and given life, not in the sense that robots are actuated, but the entirety of the physical environment is re-created as a potential source of coordinated, interdependent actions and reactions. Whether this enacted environment is actual or imagined, as Foucault argued in the case of the panopticon, it reformulates our notions of power and, moreover, our relationship to the world around us. Second, visibility both literal and metaphorical is transformed. What was solid and opaque becomes transparent, yet what makes the hidden accessible is itself invisible. Third, further erosion of the concepts of public and private force their reconsideration. In particular, questions of surveillance, control, and exhibitionism render the distinction between public and private anew. Fourth, heightened security and surveillance possibilities hold the potential to restructure civility, or public life as we know it. In Britain, in the four years following terrorist attacks in London, there was a fifty-fold increase in surveillance networks. Post-9/11 America is experiencing a similar expansion, with even more sophisticated systems and little debate about the "Orwellian potential."[1] The consequences for the public sphere are paradoxical given the intrinsic nature of information technology to bite back, to be turned and used in ways opposed to its original intent. (See Figure 1.)

This essay introduces topics for debate, essentially asking more questions than it answers. The four-part argument for a transformed public sphere raises provocative issues for architects and urbanists. Just as the panopticon spatially embodied a complex cultural order in the eighteenth-century prison, so will embodied virtuality stand as the spatial manifestation of the twenty-first century. We are only just beginning to realize the forms that pervasive computing will assume. Consider Spielburg's 2002 sci-fi movie *Minority Report*, in which futuristic biometric scanners can identify shoppers and emit a siren song of personalized consumer preferences as they pass through the mall. This portrays a near future, and it is at this generative phase of development that architects and urbanists must engage pervasive technologies. Although pervasive computing applications within the private sector, like advertising, may have a deep effect on society, I wish to explore ways that the technology is applied within and by the public sector, in particular, by the state.

Although there are clear technological precedents for the emergent, pervasive technologies, they can be distinguished from past developments by the fact that this new technology can be both everywhere and nowhere (unlike the automobile that is mobile but locatable); that it acts intelligently yet fallibly, and its failure is complex (versus the thermostat, which is responsive but singular and unintelligent); and that intelligent systems operate spatially, yet they are invisible (unlike robots). For utopians like Weiser, these distinctions suggest that an environment embedded with intelligent comput-

1. Surveillance, voyeurism, and exhibitionism collide.

ing can be nuanced in compelling and even more natural ways, "as refreshing as taking a walk in the woods." Embedded networks, however, are just as likely to spark dystopic views, as have all preceding technological breakthroughs. Now, as pervasive computing grows, there is a certain urgency to its critical review by all those concerned with the public sphere.

Cyburgs, the Enacted Environment

To be an agent, one must be somewhere.
Robert Sack (1988)

The term *public sphere* is necessary to a discussion of embedded networks because it implies not only physical space but also the metaphorical space of

public discourse, social norms, interaction, and social sentiment. I want to make a strong distinction between what has been called *cyberspace* from what I will call the *cyburg*.[2] Cyberspace is defined as having no physicality, no matter, and no Cartesian duality because there is only the mind, and communication is the only transaction. ("Ours is a world that is both everywhere and nowhere, but it is not where bodies live."[3]) If cyberspace is dematerialized space, the cyburg is spatially embodied computing, or an environment saturated with computing capability. It is the imminent stage of digital media that places computation in all things around us, from our own skin and bodies (biotechnology and nanotech medication), to our clothing, to our cars, our streets, our homes, and our wildernesses. The cyburg is the opposite of Christine Boyer's cybercity and may indeed functionally sidestep all the dystopian visions of disembodied, disengaged, socially remote cyberlife.

No longer residing in the abstract space of the Internet, digital communicating, processing, and sensing increasingly actuate the world around us. Ironically, as computing becomes more pervasive, we will exist simultaneously within both cyberspace and cyburg space. This dual existence characterizes a new postmodern space. Our own agency is enhanced by the cyburg, for we can know and act in more powerful ways. Complementing our empowerment is the newly enacted environment. Not only do the walls have ears, but networks of eyes, brains, and data banks to use for purposeful action. Although we are reluctant to attribute agency to objects in our surroundings, it is a stance that won't survive long. These embedded systems can be said to have intelligence insofar as they link diverse databases and change their response according to new information as well as the consequences of their own actions.

Baudrillard, in an essay on consumer society, says that the ecology of the human species has fundamentally mutated from a life surrounded by other human beings, to a life surrounded by objects:

The concepts of "environment" and "ambiance" have undoubtedly become fashionable only since we have come to live in less proximity to other human beings, less in their presence and discourse, and more under the silent gaze of deceptive and obedient objects which continuously repeat the same discourse, that of our stupefied (medusée) power, of our potential affluence and of our absence from one another.[4]

This could fundamentally mutate once again, as our objects/environment are no longer silent but active, nor are they obedient but indirectly willful.

New capabilities of pervasive computing systems will expedite the restructuring of everyday life because they permit what we considered the context to become a bona fide agent in the public arena. This is the opposite of early projections about electronic technology. In 1964, Marshall McLuhan wrote "The telephone: speech without walls. The phonograph: music hall without walls. The photograph: museum without walls. The electric light: space without walls. The movie, radio and TV: classroom without walls. Man the food-gatherer reappears incongruously as information-gatherer. In this role, electronic man is no less a nomad than his Paleolithic ancestors."[5] Instead, speech is issued by the walls, and the museum's walls present visitors its works of art according to their particular viewing habits, or any of myriad curatorial themes. Street lights monitor as well as regulate traffic by assessing variable fees and suggesting less-crowded routes (see Figure 2); public park sensors scan for unusual behavior and known criminals, reporting each to the authorities; smart glass becomes more obscure and reflective during the hottest part of the day; stores can identify your vehicle and send drive-by messages tailored to your past consumer behavior. These new levels of information, security, conservation, and access are balanced by heightened possibilities of intrusion, tracking, classification, and exclusion.

(a)

(b)

Thus, our urban environment can be qualitatively transformed so that it occupies a new status and role in everyday life. We can be complicit with the sidewalks, rejected or embraced by a park, bombarded in the streets with advertisements.[6] Marshall McLuhan, sometimes called the "oracle of the electronic age," argued that the content or message was not just distorted but defined by the media. Had he lived to see pervasive computing, his thesis might have extended to question the boundary between space and subject, between the advertisement, the object being advertised, and the reception of that ad. Even if we are less technological determinists than McLuhan, his analysis sets the stage for embedded virtuality.[7]

Invisibility and Exposure

Pervasive computing enhances what we can know, where we can know it, and how immediate it will be. As when Muybridge showed stop-frame action in his time-sequence photographs, infrared sensors, microsensors, and processors can network together

2. This image portrays a post-9/11 proposal to reduce traffic in lower Manhattan via remote surveillance that monitors the number of people per car to assess variable fees. The fewer passengers, the more it costs to drive on the streets.

to build a dynamic portrayal of what otherwise could not be known. Doctors can track the real-time progress of an ingested medication or see the internal anatomical details of a surgery patient; firefighters can get critical information about the fire as it rages and their rescue efforts; the migration of endangered whales can be closely monitored.

"Visualization technologies" provide access into what was opaque, knowledge where there was previously ignorance, bringing close what had been remote — all these capabilities of pervasive computing transform our ideas about space. Now that police equipped with increasingly common thermal imaging technology (and a search warrant[8]) can drive past a house and "peer through" the walls, our ideas about not only privacy, but the walls themselves must change. Even stranger is the use of the same imaging to see where a person has been — sensors of the past tense. (See Figure 3.) This new technology goes beyond the often-mentioned collapse of distance promulgated by fax, telephone, or overnight delivery. It also represents the possibility of new knowledge that will enhance safety, inform action, and provide perspective. Publicly accessible monitors that display moment-by-moment readings of everything from water quality to activity in the public square to traffic patterns can provide a type of information previously unavailable and potentially community enhancing. Pervasive computing can open up the workings of an otherwise inaccessible mystery, whether that be the performance of a building's structure in an earthquake or the nanny's behavior while mom and dad are at work. There is an irony here: it is invisible, miniaturized sensors that make formerly inaccessible realms visible.

That irony of pervasive computing is related to long-standing critical inquiry into the relationship of seeing and being seen. For example, Roland Barthes characterized the mythical status of the Eiffel Tower explicitly in these terms: because it "transgresses this separation, this habitual divorce of *seeing* and *being seen*; it achieves a sovereign circulation between the two functions; it is a complete object
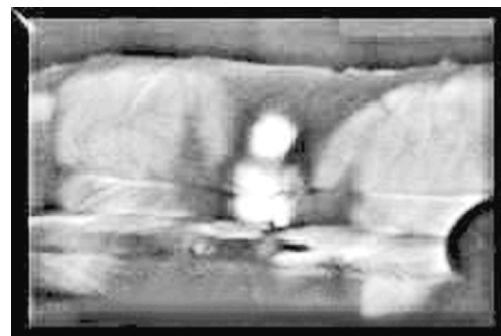
which has, if one may say so, both sexes of sight."[9] As such, it attracts meaning like a lightning rod. The digitally embedded city, strewn with sensors, pervasively monitored and actuated, is fundamentally the opposite of the Eiffel Tower. De-monumentalized, the seeing transpires with a spatial disconnect — not from a distance, but from somewhere else. The possibility of being seen, on the other hand, is everywhere. But, without the identifiable point of observation (the top of the Eiffel Tower, the center of the panopticon), surveillance becomes pernicious — potentially everywhere, by any agency, for unknown purposes. Embedded systems create the opposite of monument, the opposite of geographic centeredness, the opposite of subjectivity and objectivity. Consider the extensive implementation of closed-circuit TV in London as well as other cities in Great Britain. Journalist Jeffrey Rosen found that the cameras, intended to reduce terrorism, were primarily used to watch hookers, girls in tight T-shirts, and young men of color. Expected to protect society, bored security guards become voyeurs, reasserting

their own discriminatory stereotypes and sending a chill over public behavior.[10]

In privacy debates, some take the position that signage to the effect of "camera surveillance in operation" must be required. But how far should the signage go? It could also post: "by the London Police," "your facial features will be scrambled," or "connected to Interpol database." Such signage under our current assumptions of the city is the public space equivalent of Duchamps's "Ceci n'est pas une pipe." Being watched for unclear purposes by uncertain authority contradicts basic notions of public space.[11] The uncertainty goes hand in hand with nanotechnologies, with embeddedness, with surveillance, and even closed-circuit TV. Unlike Maupassant who could choose to dine in the Eiffel Tower to both escape its presence and reverse its relation to the city, the surveillance state is intrinsically omnipresent. There is no escape except perhaps to exhibitionism.

Private and Public

Exhibitionism, the tendency to show off something that is generally held to be private, is part of modernity and has long had its spatial component. When Napoleon III and Georges Eugene Haussmann opened the great boulevards of Paris in the mid-nineteenth century, cutting swaths through working-class neighborhoods to link axial monuments, they also ushered in modern urban life. Baudelaire wrote about this new unified city space, a space of human activity and physical connectedness. Wide sidewalks, streets lined with trees, cafes, and multitudes of citizens from across Paris came to characterize the city. A new public realm was made, and with it came a new definition of the sixteenth-century dialectic between public and private. By some accounts, these highly public gestures created the frame for a kind of anonymity, so that the street both concealed and exposed its drama simultaneously. Marshall Berman, in his analysis of modernity, says, "For lovers, . . . [Haussmann's Parisian] boulevards created a new primal scene: a space where they could be private in public, intimately together without being physically alone."[12]

Haussmann's boulevards shaped the modern city, opening intimacy to publicity across Paris, but they also promoted state control of the physical whole and the populace. A parallel transformation is occurring in our own decade: the reformulation of public and private urban life resulting from a sophisticated, digital connectivity. Even now, wireless networks available to cell phones and a variety

of handheld devices enable people in public space to engage in a new primal scene: a space where they can be private in public, but, unlike Haussmann's Paris, intimately involved with *no one* intimate present, surrounded only by the company of strangers. Wireless internet already exists at offices, airports, and college campuses, and more recently commercial establishments like Starbucks are instituting their own networks available to customers for a fee. The results are paradoxical: greater connectivity coupled with increased isolation, intimacy paired with distance, privacy with publicity. Although the multiple effects of pervasive computing will take time to comprehend, new displays of intimacy and their dismal shadow, terrorism, are enabled by transformations of visibility, privacy, and publicity.

Some of the effects of pervasive computing are clearly extensions of those wrought by the telephone and the automobile, heightening individual privacy in the city, collapsing spatial distance, and restructuring physical space. But some consequences are unique to the electronic age. Perhaps the most profound effect concerns the realms of public and private, traditionally separated by semi-public/semi-private zones. This continuum has served to describe regions of social life and space for centuries. Public life, public space, and public man have stood for a certain notion of civility where chance interactions among strangers produce a societal tolerance. Many technological advances and social transformations have been accused of weakening the public sphere, including the automobile and the concomitant suburbs, the air conditioner, and the elevator and resultant skyscraper. However, only the most recent technological innovations threaten to dissolve the public-private continuum all together. This is possible when what was once considered private is integrated and exposed in public — our intimacies (for example, cameras that watch bedrooms and bathrooms on reality TV) and our secrets (such as medical, legal, and financial databases linked to a national identity card).

In *The Fall of Public Man*, sociologist Richard Sennett decries the crisis of public culture, arguing that public life had succumbed to an ideology of intimacy and personality, in turn sparking the transmutation of political into psychological order. If we agree with Sennett, then the eroded boundaries between public and private are merely further dissolved by the advent of embodied virtuality. But, whereas Sennett saw public man in a free fall, it may be that pervasive computing in some sense restores his notion "that people grow only by processes of encountering the unknown."[13] Might the

continuous representation of the unfamiliar, the unseen, and the remote counteract isolationism and withdrawal from public life? Similar to the way that Jacob Riis's photographs of the slums at the turn of the century showed "how the other half lives," there are ways that remote sensing could expose previously hidden worlds. To adopt the view that the private is public requires the replacement of Sennett's public man with a subject no longer bound by conventional public-private distinctions.

Privacy, at the other end of the traditional polarity, has been defined as the achievement of desired levels of boundary control and access.[14] Thus, I have privacy if I can keep unwanted visitors from my home or resist intrusions while engrossed in a book. Indeed, privacy has been formulated as the central concept integrating sociospatial behavior. This notion of privacy hinges on individual subjectivity: my desired levels of access, my boundaries. It seems obvious to anyone experiencing "cell yell" (private cell phone conversations audibly broadcast to proximate strangers) that boundaries are difficult to establish, but it may be less obvious that these boundaries are corroding. The continuum model, from private to semi-public to public, might instead be replaced by a nested metaphor in which publicity has infected privacy in every conceivable context, and vice versa. Moreover, embedded networks undermine the pretense that we control our environment or our boundaries within it — a pretense that is fundamental to the construct of privacy.

The usurpation of privacy by means of technology is a modern phenomenon but not a new one. Indeed, the concerns about pervasive computing's intrusion into everyday routines were echoed in Rudofsky's 1955 book on American domesticity and an unnervingly diminished solitude in daily life. He worried about media technologies replacing conversation with mere listening:

> The latest invention in the art of listening introduces a prankish element into what is left of social intercourse. The pocket recorder, a gadget heralded as "of unparalleled usefulness," can be counted upon to remove the last dregs of privacy from our lives. Originally designed for military and diplomatic secret service, it enables everyone to strike out a line of one's own murky practices; . . . "Just stick it in a pocket and pin a tiny mike under your lapel (or wear the facsimile wristwatch mike!) — [the joyous exclamation point is theirs, not mine] — and you can record the words of anything within about twenty feet; you simply put your hand in your pocket and flick a silent switch."

What, one may ask, makes the promoters of the new furtiveness so sure that we shall keep on talking?[15]

He goes on to imagine counterspying techniques, like scattering "anti-acoustic confetti" all over our houses. Sounding like an inversion of the "smart dust" being developed for military purposes, Rudofsky's concerns may have been technologically prescient but socially off base. Legal privacy standards maintain social norms, but, at the same time, social norms evolve so that "the last dregs of privacy" are redefined. Perhaps the increasing numbers of surveillance cameras will have no more chilling effect on social life than did the tape recorder. But, on the other hand, one could say Rudofsky's worry was merely misplaced: Walkmans, not secret listening devices, are the pocket recorder's greatest blow to social intercourse.

If our awareness of the new social roles for wireless technologies was growing before September 11, 2001, it became our collective nightmare as last, loving calls were made from cell phones at the top of the World Trade Center and from within the fourth airliner before it crashed in Pennsylvania. As it turned out, terrorists too were linked by cellular technologies that suited their mobile, network-structured organization. In the wake of 9/11, a surveillance society lurks. We can look again at the case of Great Britain: after terrorist attacks in London in the early 1990s, installation of closed-circuit cameras to surveil city streets and squares increased dramatically. In 1994, 79 city centers had surveillance systems; there were 440 such systems by 1998; and by 2001 there were more than 2.5 million surveillance cameras across Britain. There, the average citizen is photographed three hundred times each day.[16] By contrast, the average American was photographed seven times a day in 2001 by surveillance cameras. Since 9/11, there has been a proliferation of surveillance systems like the one hundred cameras proposed for Times Square, and three hundred for Los Angeles International Airport.

The effect of ubiquitous surveillance cannot yet be known, but it is clear that security interests of the state have negative consequences for individual privacy. The Patriot Act, signed into law just one month after 9/11, expedites counterterrorism efforts by easing restrictions on electronic surveillance. Our online activities are more likely to be monitored, and data is easier to collect from Internet service providers in what is often called "domestic spying." In Washington, D.C., police activated a "command center" after 9/11 to monitor in integrated ways criminal databases and surveillance cameras that operate in "shopping areas, streets, monuments, and other public places in the U.S. capitol."[17] Proposals for a "smart" national identity card resurface regularly, with computer chips to identify the user, limit access, and track the user's criminal history, location, travel speed, and financial transactions, for starters.

We can be certain that privacy will not be the only terrain in which social impacts will result. Sociologist Anthony Giddens describes the "disembedding" mechanisms of modernity. By this he means those mechanisms that break apart social relations across space and time and that remove local control of resources, services, information, and even the mechanisms themselves. Pervasive computing used as a tool of surveillance is a disembedding, abstract mechanism, because the sensors, processors, and actuators are anonymous. Thus, although any abstract system requires trust of the anonymous (such as that nuclear reactors are built well enough to withstand terrorist attacks), that trust is intertwined with intrinsic doubt. The streets are surveilled by the police, yet we know that the police are not always trustworthy and that surveillance systems can be hacked. The pervasiveness of the systems is astounding: as early as 1998, a map of "every camera, public or private, which records people in public space" in Manhattan documented 2,397 such cameras.[18]

It may be the urban designer's task to create physical space or new forms of visibility to restore social bonds. In their project entitled "Refresh," architects Diller + Scofidio created a project from a dozen office webcams. (See Figure 4.) In considering why these cameras exist, the architects say

> The live cam phenomenon can be thought of as a public service, or a mode of passive advertisement, or it may be a new type of exhibitionism, or self-disciplinary device. The desire to connect to others in real time may be driven by a response to the "loss" of the public realm. But however varied the motives, live cam views always seem casual and lacking dramatic interest and content; they appear unmediated. Despite this apparent innocence, cameras are willfully positioned, their field of vision is carefully considered, and behavior within that field cannot help but anticipate the looming presence of the global viewer.[19]

In such applications reside possibilities for critique and modification of pervasive surveillance. And the critique emanating from the arts can spark debate that contributes to evolving social norms. Consider Lars Spuybroek's D-Tower project for Doetinchem in the Netherlands. The whimsical multimedia project includes a web site that surveys participating towns-

4. Diller and Scofidio's first web art project, for the Dia Foundation, investigates live office webcams.

5. D-Tower (a tower, a questionnaire, and a web site) for the city of Doetinchem. (Project by Lars Spuybroek of NOX studio in Rotterdam, in collaboration with artist Q.S. Seafijn, 1998–2003.)

people's emotions on a monthly basis, and those emotions are in turn displayed in differing colored surfaces of the tower: when it is deep red, passersby know the town is feeling more love and happiness than hate and fear. (See Figure 5.)

Public Life

The preceding examples hint at possible ways that pervasive computing will nudge a newly defined public life into existence. It will be part of the historical trajectory of technology's sociospatial implications for public life, as is the development of plate glass with the resultant shop window, and the television with the interiorization of residential space. In "A Manifesto for Cyborgs" (cybernetic organisms, like us), Donna Haraway argues that digital capabilities will transform everyday life: "No longer structured by the polarity of public and private, the cyborg defines a technological polis based partly on a revolution of social relations in the *oikos*, the household."[20] Just as Haraway sees the restructuring of the previously private household, there are parallels in the public sphere where common ground grows more individuated and privatized because of wireless technology. And public space can incorporate, even publicize, that which was remote and inaccessible: a town broadcasts its emotions, or a school projects the children's collabora-

tive art project as it develops or webcasts their music lesson.

Foucault's analysis of the panopticon captured a formal-social symbiosis, whereby a spatial model arose to typify and exemplify a complex nexus in cultural history. Koolhaas's description of the skyscraper as proximate stacking of unrelated lives captured the essence of the twentieth century. The immanent equivalent is the city of embodied virtuality: the cyburg for cyborgs. The embedding of tiny computers and their networks into the city brings promise and uncertainty. Creating a realm of dispersed displacement, surveillance aims toward a particular space or spaces. It — and we know not what or who *it* is — observes us and our actions, emotions, histories, and reactions. These observations may be known to us (screening for passenger-carried weapons at airports), uncertain to us (visible cameras linked to unknown processors, such as face recognition systems and criminal data bases), or opaque to us (cyber-interceptions of potential terrorist communications). Thus, the actuated environment, our actuated surroundings, can now "manage" not only that which is capable of being seen and known, but also that which is not capable of being seen, and about which we remain ignorant.

In a realm of dispersed displacement, discourse about centers and margins becomes irrelevant. For lovers walking hand in hand while speaking simultaneously by cell phone to their respective spouses, spatial dislocation is crucial and unquestioned. In this they remain secure. But they cannot be certain even about the immediate other: with whom is she speaking? Is she with me, or is she elsewhere? In this context, the other is not just distracted; neither is she absent. Instead, she is both present and absent in a way that was not possible prior to wireless technologies whereby everywhere is connected. There is no spatial logic nor spatial guarantees for intimacy. Publicity likewise embodies uncertainty. Public life is spatially located but also displaced and dispersed, requiring new logics and new physical forms.

Conclusion

The age of pervasive computing is immanent; its implications for architecture and for the city are just beginning to emerge. It is clear that ubiquitous and mobile systems will alter fundamental ideas about public and private, civic life, invisibility, and environmental agency. Each of these terrains is situated within the domain of design, giving rise to new architectural concerns. The existing literature projects consequences with either a utopian tone (as with Weiser's seminal article of 1991 and William Mitchell's *e-topia*) or a dystopic view (such as Rosen's essay on British CCTV).[21] Instead, in this preliminary exploration of issues, I have tried to present a double view, utopian and dystopian, equally aware of the promise and uncertainty that lies within embedded networks. Under such circumstances, the architects goal must be to embed civility in a pervasively computerized public realm.

If the "public geography of a city is civility institutionalized" and if civility is, as Sennett puts it, "treating others as though they were strangers and forging a social bond upon that social distance," then the designer must invent means to embed the possibility of civility into both new pervasive technologies and new urban geographies.[22] What does it mean to embed civility in the public sphere? I would offer three linked guiding principles — information, choice, and control — which architects must find ways to embody in physical form. The first goal is to provide useful information about the embedded networks so that the public maintains an awareness about otherwise imperceptible systems. Information then contributes to people's ability to make choices about their public lives, and simultaneously returns to them a degree of control. A parallel from the 1960s and early '70s: the Vietnam War protests and "love-ins" that rejuvenated life in urban America's public sphere were catalyzed by television broadcasting. Anti-surveillance web camera performances in public settings are a similar phenomenon. Until

awareness of pervasive computing is heightened, the lack of public debate restricts architecture's full participation in the project to embed civility.

Nevertheless, the simultaneous existence of cyberspace and cyburg space creates a sociospatial-digital arena like none before. It's origins are inherently modern: the modern world of contradiction and display, and where, as Marx famously put it, "all that is solid melts into air, all that is holy is profaned." In Giddens's conception of the late-modern condition of increasingly abstract systems, he cites intensifying conditions of risk and danger. Within his array of risks, one component is the created environment or socialized nature. This is "the infusion of human knowledge into the material environment." Giddens identifies rightly "the altered character of the relation between human beings and the physical environment."[23] What I have called the *enacted environment*, Weiser's embodied virtuality, is knowledge extended such that the material environment is infused also with intelligent action and reaction, data gathering, surveillance, and networked information. The intensity of risk increases substantially, but so can the intensity of experience.

Giddens concludes his exegesis of modernity with the ways it might be engaged, which parallel the ways an era of embodied virtuality could be engaged: pragmatic acceptance, sustained optimism, cynical pessimism, and radical engagement. The last is the domain architects and urbanists must inhabit when designing to provide information, choice, and control. Radical engagement, or what Giddens at one point calls *utopian realism*, is indeed the ken of designers who use their expertise to reveal, contradict, play with, or intervene in pervasive computing. As a first step, designers are projecting information on surfaces that were formerly static. (See Figure 6.) Works are increasingly interactive and customized. (See Figure 7.) Here, the opportunities for informed choice and control can grow in complexity, sophistication, and diversity over the coming decade. The immanent domain of a newly public realm depends upon it.

6. Digital House. (Project by Hariri and Hariri, 1998.) Both interior and exterior walls are liquid crystal displays in this demonstration of new electronic technology for *House Beautiful* magazine.

7. Spuybroek's water pavilion for the Ministry of Water Management and the Destra Expo (1994–1997) in the Netherlands. The building incorporated digital sensors to activate light, sound, and projections according to the visitors' movements through the space.

Notes

1. See David A. Fahrenthold and David Nakamura, "Council Attacks D.C. Surveillance Cameras," *Washington Post*, Nov. 8, 2002: B01. There is a growing literature and spreading activist movement against the recent, rapid expansion of video surveillance systems. Two web sites documenting activist projects are from the New York Civil Liberties Union (www.mediaeater.com/cameras/) and from Washington DC's Electronic Privacy Information Center (www.epic.org/privacy/surveillance/).

2. *Cyberspace* was first coined by science fiction writer William Gibson, then taken up in architecture by writers like Michael Benedikt in *Cyberspace: First Steps* (Cambridge, MA: The MIT Press, 1991) and Christine Boyer in *Cybercities* (New York: Princeton Architectural Press, 1996).

3. From "A Declaration of the Independence of Cyberspace," John Perry Barlow, who first applied sci-fi writer William Gibson's term *cyberspace* to the digital social space enabled by the Internet. See http://www.eff.org/~barlow/Declaration-Final.html.

4. Jean Baudrillard, *Selected Writings,* Mark Poster, ed. (Stanford: Stanford University Press, 1988), p. 29.

5. Marshall McLuhan, *Understanding Media: The Extensions of Man* (Cambridge, MA: The MIT Press, 1998), p. 283.

6. The formal likenesses between physical urban infrastructure — the sidewalks, streets, systems of parks, sewers, and electrical grids — and pervasive computing networks facilitate each one's absorption of the other.

7. McLuhan also recognized the connection between space, society, and technology. In his discourse on the book he says, "Printing, a ditto device, confirmed and extended the new visual stress. It created the portable book, which men could read in privacy and isolation from others." Marshall McLuhan, *The Medium Is the Massage* (New York: Random House, 1967), p. 50.

8. See Linda Greenhouse on the Supreme Court decision regarding privacy and thermal imaging searches. "Justices Say Warrant Is Required in High-Tech Searches of Homes," *New York Times*, June 12, 2001.

9. These are Barthes' italics. *The Eiffel Tower and Other Mythologies* Richard Howe, trans. (New York: Hill and Wang, 1979), p. 5.

10. Jeffrey Rosen's informative essay entitled "A Watchful State," was published just after 9/11 in *New York Times Magazine,* Oct. 7, 2001: 38–43, 85, 92–93.

11. For a comprehensive and articulate discussion of the changing notions of public space, see Anastasia Loukaitou-Sideris and Tridib Banerjee, *Urban Design Downtown* (Berkeley: UC Press, 1998).

12. Marshal Berman, *All That Is Solid Melts Into Air* (New York: Penguin, 1982), p. 152.

13. This is the concept of public life constructed by Richard Sennett in his seminal book, *The Fall of Public Man* (New York: Alfred A. Knopf, 1977), p. 295.

14. Irwin Altman offered this classic definition of privacy in *The Environment and Social Behavior* (Monterey, CA: Brooks/Cole, 1975).

15. Bernard Rudofsky, *Behind the Picture Window* (New York: Oxford, 1955), p. 196.

16. Jeffrey Rosen, "A Watchful State," *New York Times Magazine*, Oct. 7, 2001.

17. Reuters, "Washington Plans Unprededented Camera Network," New York, Feb. 13, 2002.

18. See www.mediaeater.com/cameras.

19. See http://www.diacenter.org/dillerscofidio/intro.html.

20. Donna Haraway, "A Manifesto for Cyborgs: Science, Technology and Socialist Feminism in the 1980s," *Socialist Review* 15/2, 80 (March-April 1985): 67.

21. Mitchell's *e-topia* argues that digital technology will transform the city in myriad positive ways (Cambridge, MA: The MIT Press, 2000).

22. Richard Sennett, *The Fall of Public Man* (New York: Alfred A. Knopf, 1977), p. 264.

23. These two quotes are taken from Anthony Giddens' *The Consequences of Modernity*. (Stanford: Stanford University Press, 1990), pp. 124, 127.