Building a Culture of Ubiquity

Patrick Lichty

(*Editor's note: As this may seem slightly dated, this presentation was originally part of the Emotional Architectures summit at the Banff New Media Institute in 2000. It is being included as it has never been published, and is a fundamental statement of my fascination with art and the body. It also has some prescient moments. - PL)*

For some time now, my personal interest in artistic practice is that which looks to capitalize on what I call the "cracks" in our culture. In this I relate to those interstitial parts of society which offers possibilities to the practitioner for delivery of cultural content. These include screensavers, Personal Digital Assistants, intelligent agents and microcontrollers to name a few, and I gave a talk called "the next little thing"[1] in 1999 at the *Invencao* symposium in Sao Paulo, Brazil. In that presentation, I looked at these cultural gaps and how art that utilizes them challenge monumental and novel forms of technological art through utilizing 'small systems initiatives'. By this, I mean the use of small, inexpensive, or transparent technologies to communicate a cultural or aesthetic experience through a sense of personal engagement. My practical inquiry since that time has broadened to include information appliances, responsive environments and cybrids [2]. Such a practical turn makes visible that the inquiry into "small systems initiatives" is actually a journey into the exploration of a culture of computational ubiquity. In my body of research vis-à-vis the shift in praxis from the screen to the palm to the body to the space, there are issues of representation that are revealed through the way that aesthetic content is embodied through the interface. This interface may be a screen, dataglove, head-mounted display or responsive space, but each mode of representation illustrated by each display or input device indicates a unique space of interaction and expression, whether on the screen body, or reinscribed in space itself. As we consider the arc of praxis from screen to body to space, perhaps this may create some insight into how a culture of technological ubiquity will be constructed, and what modes of expression may emerge from such cultural forms and technological developments.

the proliferation of personal information devices, personal computers ... is creating the environment for the establishment of a culture of the digital...

From a cultural perspective, the proliferation of personal information devices, personal computers, and explorations into technologies like Augmented Reality is creating the environment for the establishment of a culture of the digital. To add these devices together under the proposition that the presence of any technological agency will create its own cultural milieu is ill-founded, as the widespread attention to technological art forms has not been evident until recently [3]. The catalyst for the rapid expansion of a technological aesthetic has undoubtedly been the Internet, with its predilection for community building. This was evident from the Walker Art Center's former Gallery 9, with its extensive online archives and exhibitions, reflecting the move of art in the digital age to exploit a communicative mode of expression. In fact, Steve Dietz in an introduction voiced his awareness of the emergence of such a culture, and voiced his desires to support it, [4] "If we are at the formation of a next phase of technological society, then let us partner with developers and scientists as practitioners of the arts to create a cultural content which is thoughtful and incisive to conditions of the society."

My reflection on these words is that a portion of the world is moving toward a society in which information technology is saturating us to the point where there is a threshold for the creation of a culture or set of cultures, niche to mass, which are unique to the electronic milieu. This saturation is in the form of personal information devices, PDA's, and the proliferation of embedded controllers like so many nanomites circulating in the air in Stephenson's *The Diamond Age*[5], As I alluded to before. The catalyzing forces behind this cultural shift are connectivity between individuals and decentralized distribution of communication and content. These factors underlie the creation of the electronic culture, and are essential to the work described here. But, as this portion of humanity moves towards a culture of ubiquity, there are a series of localities that may serve as points of analysis for the communications of cultural codes. Each (the screen, palm/pocket, body, and public space) has unique modes of representation that allude to Hayles' linkage of the subject between its signification and the embodiment of experience [6]. All of these localities make visible systems of production, consumption, and representation that illustrate a possible ecology of signs within a culture of ubiquity.

The Screen -->

The most familiar embodiment of engagement with the digital/technological is the screen, and as such, exhaustive studies have been made of our interactions and representations of the aesthetic [7] that any more than a brief discussion falls outside of the scope of this article. Seminal works include titles by Sherry Turkle (*Life on the Screen*), and Brenda Laurel (*Computers as Theatre*) to name just a couple. However, the interesting point to most explorations of the ontology of the computer monitor is that they reflect the two-dimensionality of that visual plane as many critiques refer to textual and cinematic analyses of the virtual screen. This is to be expected, as much of our familiarity with the computer screen is that of a cinematic engagement through games, graphics and animation, or via the textual world of the word processor..

GameBoy Color, Courtesy Nintendo

...much of our familiarity with the computer screen is that of cinematic engagement through games, graphics and animation, or via the textual world of the word processor.

Another aspect of the screen, and we will see modulations in this effect, is some degree in our other manifestations of the human-computer interface, is that of its performative quality. This follows from Barthes' argument of the active role of the reader [8] in which the construction of meaning is now as much in the eye of the computer user than the programmer or media producer. Case [9] takes this further in positing that the electronically augmented writer and reader have to follow certain ritualistic procedures inscribed by the program and operating system, creating a 'performative' aspect to mediated electronic interaction. So, what I am positing here is that through the embodiment of any form of information, the mode of representation, interaction, and feedback creates a specific environment and context for the communication of any cultural content. In the case of the screen, we can see that it operates under certain rules of dimensionality, temporality, and interfacing protocols, such as the mouse/keyboard and size of screen that presents its unique ontology to the human organism.

The Hand

Following from this systematic reading of the screen as interface for the embodiment of digitally mediated experience, let us take the first shift off the screen and onto the hand. From the creation of Mattel *Electronic Grand Prix* to the Nintendo GameBoy [10] and Tamagotchi, electronic games are the precursors to the information appliance, and have been with us for over twenty five years. The introduction of information processing (PDAs), and cellular phones (distributed networks), create the opportunity for the creation of aesthetic experiences in the interstitial 'cracks' in distributed/cellular networks and highly localized devices like the Palm and Pocket PC. These devices, such as the Web-enabled cell phone and PDA/PocketPC have only been recently been recognized in the US as a platform for the delivery of cultural content. Currently, I know of few artists using these devices [11], probably due to their diversity of operating systems and nascent level of development/proliferation. However, the wireless networks bridge the gap between the Internet and cellular networks, and are the next logical step towards a ubiquitous transmission of cultural codes.

The information appliance is an intimate space, unlike the larger, more paper-like or cinematic space of the screen.

The information appliance is an intimate space, unlike the larger, more paper-like or cinematic space of the screen. Even at the level of the device as a chip on a board embedded microcontroller, it hearkens to systems in which the body is biometrically linked to the digital aesthetic space, or that the experience could be distributed across numerous small devices in large collaborative interactions. On another level, the information plays on the precious and fetishistic, as is evident in specialty items like gadget watches and PDAs for teenagers [12]. Because of these aspects of such technologies, it is logical that there is a specious quality about these devices that bears investigation.

In my own work, I have been interested in the information appliance as a place to subvert the intimate (both through violation of the 'trust' of the OS/user interface and creation of distributed collaborative spaces), to

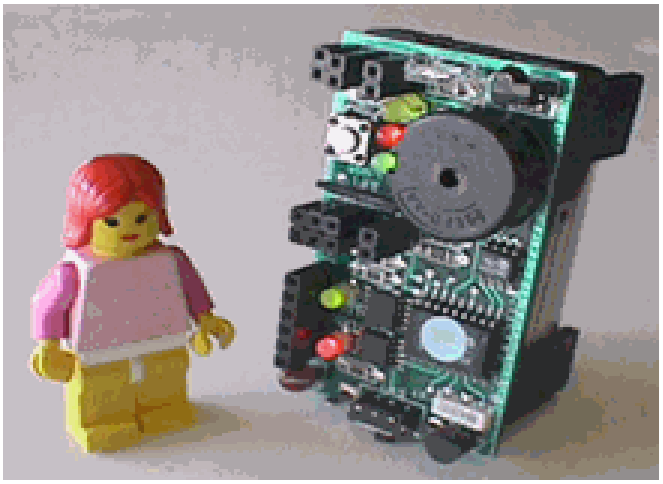
create networked experiences, and to become emotionally involved with the information structures we create. A project developed with the generative music company Sseyo was the *SseyoPhone*. [13]. The important concept for the phone is that is creates a step towards individual expression through the information appliance.

SseyoPhone, Courtesy Sseyo

This was done through allowing the user to use generative music algorithms to create unique 'signature' ring tunes and network-based collaborative jams. In so doing, it questions the role of collaboration and collective interaction in distributed environments by blurring the line between the artist/musician and the sampler artist/interactor. The phone itself illustrates the aesthetic object as McLuhanist prosthetic, and transparent (yet still physical) interface to the digital sphere. Its mode of representation is still rather straightforward in following semi-traditional compositional and game play processes, but what may be even more exciting are culture jamming experiments for this type of platform.

For example, one concept that plays on short-circuiting the intimate level of trust implicit in the functioning of an operating system is my series of *Alpha Revision* [14] interventions called "the Graphic User Interface". In one, based on Perry Hoberman's *Error Message* series, the user is greeted to hostile and ambiguous error messages when the applet is enabled in the Pocket PC. Instead of the usual error message, the user is treated to insults, arguments about Microsoft, and other comments which problematize the role of the palmtop as subservient assistant. In the other *Graphic User Interface*, the desktop is replaced by the visage of a mangled corpse, and the space of interaction is transformed into a forensic dissection table as the parts of the dismembered body replace the program icons.

However, culture jamming and generative music collaborations represent only two ways in which representation, interface and feedback combine in ways that are specific to the hand or pocket. A 1998 work by Simon Penny and Jamieson Schulte entitled *Sympathetic Sentience* [15], creates "complex patterns of rhythmic sound through the phenomenon of 'emergent complexity'" through a spatial matrix of twelve dedicated microcontrollers equipped with infrared transducers. Each device emits its own musical code through an infrared transceiver, which is then represented by audible tones. When the signal reaches the next device, its own algorithms add or subtract from the tonal sequence. The process continues until the tonal stream meets certain informational saturation and the tonal stream continues its mutation. Although this installation has little interaction with the human onlooker, is illustrates an embodied experience in which information is embedded into the gallery space to create a representational space for the mutating stream of musical tones as aesthetic metaphor for the data itself. Such a space alludes to the small tamagotchi-like 'love pendants' [16] which displayed various actions dependent on the attributes of the pendants around it (programmed personality traits, gender, etc). To take the metaphor even further, such a space could be taken to localized venues where pocket PCs or other PDAs could establish their own emergent communities through the transmission of aesthetic data. In this way the intimate duplicates itself into a local, or handheld form, one encompassing the local network, and the next expanding into numerous clusters of communities.



Cricket
(with LEGO figure shown for scale)
Courtesy Mitchel Resnick

Another way we embody experience through informational structures is through our toys. Any number of intelligent toys have come on the market, but of interest to me are the open-ended toys like the *LEGO Mindstorms* [17] home robotics system, which was developed at the MIT Media Lab. Mitchel Resnick's [18] work, utilizing small PIC microcontrollers similar to those used in the Mindstorms kit, used with the LEGO block system deals primarily with the concept of learning through the use of cognitive computational tools. These toy-like tools create a transparent culture of

computational ubiquity in the form of 'smart' beads, differing sensor blocks and mini-bots. In using these tools, Resnick has used the play-space created by the cognitive patterns of construction with the LEGO blocks to impart knowledge about abstract concepts like complexity, and to create a more accessible interface to technology to groups such as disadvantaged children.

Resnick's work in his "Beyond Black Boxes" [19] project also bridges between the space of the body and the handheld information appliance. The devices consist of small microcontroller driven LEGO bricks that exhibit simple functions. These blocks, called the Crickets, are programmable devices that could communicate, sense or perform other functions. The potential for these blocks would be for telemetry, communication, research of social patterns such as viral transmission, and so on. The *Cricket* devices engage in the intimate locus of the toy as an interface with informational spaces, and possibly could even serve as interfaces whose signification slides between desktop computation and technologies such as smart clothing. They reflect the tool as agent of expression, and resonates with the human organism's sense of play and use of symbolic objects.

To the Body -->

From looking at the aforementioned work, there has obviously been much work done in information appliance technology, and Resnick's work leads this investigation to the next step on our epistemic arc from the screen to space onto the body. As the modes of communication, representation, and interaction shift with the move from desktop computation to handheld devices, what is the shift that is created when the site of engagement moves from the hand to the body? What are the issues that arise when the corpii of flesh and information are so closely signified? Technological artists have been wrestling with these concerns in virtual reality for some time, but my concerns are less about the HMD-based sensorium than the embodiment of information on the flesh itself. Jaron Lanier, in a 1998 lecture [20], spoke of his interest in certain cephalopods in the South Pacific that communicate by changing the pigmentation/phosphorescence of their bodies. In this case, the display device is more akin to a transmission device between individuals than an interface between the individual and the informational space itself. Lanier's metaphor drew my interest when it is applied to a device I saw at Philips Design. It consisted of a jacket that incorporated a fiber-optic based display that was woven directly into the garment itself. Although the area covered on the jacket was relatively small and low in resolution, it illustrated that the communicative potential for garments that would serve as an overlay for the body of information relating to the individuals status, expressive nature, or other metaphors for 'body language'. In such a device the interface with the informatic realm would then become manifested outwardly, and could display 'bodies of text' [21], biometric information for those under medical care, or concurrent levels of communication with human and electronic counterparts[22].

An extant work that engages with the concept of concurrent layering of meaning through the use of embedded technology on the body is the author's *Internal Monologues* work[23]. In this piece, a Magritte-style bowler is outfitted with three components: A fluorescent alphanumeric display mounted on the front of the hat, an embedded microcontroller, and a voice recognition unit which sends information to the first microcontroller based on certain predefined patterns of speech. In the initially proposed configuration, the hat would then overlay an typically provocational 'subtext' onto the display, playing with cultural idioms like 'talking out of your hat' and 'it's written all over your face'. Other planned installations include an interface to the Internet so that online participants can transmit their own content into the display, creating a representational disjuncture between the artist's actions and the inscription of others' narrative onto the artist. With such an installation, the hat then becomes an embodiment not only of the informational space of the artist's expression, but also of a distributed community's voice as well.

Internal Monologues
Interactive Communications Hat
Courtesy Patrick Lichty

What is the shift that is created when the site of engagement moves from the hand to the body?

What are the issues that arise when the corpii of flesh and information are so closely signified?

Each of the bodily manifestations so far for aesthetically-based wearable technologies has stressed the device as communications display (outward flow of information from the wearer), but such a discussion of this particular genres must also include certain aspects of wearable computing. This particular genre will not be covered in depth here other than a mention of the MIT Wearable computing group [24]. The experiential shift that the work done by the MIT group is significant as it represents wearable computing as expression of fashion, or as possible platform for distributed performances, like Tina LaPorta's *Call and Response* [25], which utilized several individuals across a CU-SEEME link. Secondly, wearable computing reverts the gaze of the interactor to the primacy of the user, and not of the onlookers, as in our previous examples. When linked to technologies like the Philips fiber optic cloth, wearable computing could provide powerful platforms for personal expression, but in their current state, express more about commodity power and represent only slight paradigmatic shifts from the desktop. I do want to mention that various interventions that question the panoptic quality of computation have taken place with this group, but the bulk of information relates to the production of viable wearable computing products.

Between the Body and Space

One genre where the potential of wearable computing surpass its objectified commodity power is that of Augmented Reality, in which a head mounted display or wearable computer overlays graphic information over the view of the user in real time. It is an inversion of the informatic overlay onto the body speculated by the Philips fiber jacket, as the body of information now is superimposed upon the world and presented to the individual. The infosphere is now a representational spectre, moving in real time, but the physical world is now the interface, creating tightly linked heterotopic spaces instead of multiple bodies. .

At SIGGRAPH 2000, an ATR Japan project, entitled *Augmented Groove* [26] utilized simple machine vision linked to paper cards that, when manipulated, controlled musical and video elements on a monitor as participants manipulated the physical objects in the booth. Multiple participants could partake of mixing the audio and video to create the live dance mix creating a cybrid collaborative dataspace consisting of physical implements, performers, the interface world, and the resulting entertainment media space. A number of spaces are actually created in this piece, each unique for the user, but still representative of the doppelganger informational space that intersects with the performers. An important note to the installation was that the description on the SIGGRAPH 2000 website stated that the installation uses head-mounted visors. The actual installation utilized a large-scale projection screen as well as the audiovisual media output monitor, and thus alluded to the inscription of infosets onto physical architectures through the creation of responsive spaces rather than the AR interactions previously intended..

Augmented Groove AR controller
Courtesy ATR/Japan

SPACE

In seeing the *Augmented Groove* with a projection rather than a visor, it brings to the fore the issues of the aesthetic experience where the space itself is inscribed by the body. In this case, the wearable display garment inverts off the body, becoming architectural. Further still, in a responsive environment, the interface becomes transparent. Unlike Augmented Reality, in which the embodiment of the informatic world is still mediated by the worn display, the physical environment is now the tangible interface. The body needs few interfaces such as keyboards or mice, as the space itself represents the doubling of spaces for interaction. The technology has thus become transparent in that the responsive space is now the interface with the body of information. There are various ways in which the body can reinscribe the cybrid physical/media space through different methodologies of sensing and telemetry. The body and space can be correlated using attached sensors, translating the body directly into the surrounding architecture, to the use of embedded sensors throughout the public area itself. Our arc of experiential embodiment from the desktop to the space through the hand and then the body projects the informatic corpus onto the environment, imbuing a synaesthenic quality upon the intersection of physical, informational, and corporeal spaces, blurring that meeting of worlds. By the time our discussion reaches the milieu of responsive architectures, the space itself has reached a stage where it has transformed to the point where the distinction between spaces has become duplicitous and unclear.

This sense of transmutation of space is evident on the Sponge work, *M3 T-Ggarden* [27], as stated in their description: "*T-Garden* is a responsive environment

where visitors can put on sound, dance with images and play with media together in a tangible way, constructing musical and visual worlds 'on the fly'. The performance dissolves the lines between performer and spectator by creating a social, computational and media architecture that allows the visitor-players to sculpt and shape the overall environment…The media use a dynamic language that can be compared to the movement of verbs instead of the symbolism of nouns."[28]

The *T-Garden* has become a multifaceted performative dataspace in which the body sensors within the participants' costumes allow them to sculpt a media grammar of architectural space through performance. According to Kuzmanovic, [29] this refers to the transmutative qualities of alchemy in which a space and its inhabitants have made the transformation into a fluid environment in which distinctions between performer and audience, language and media, and the traditional grammars of representation are left for reinterpretation moment to moment.

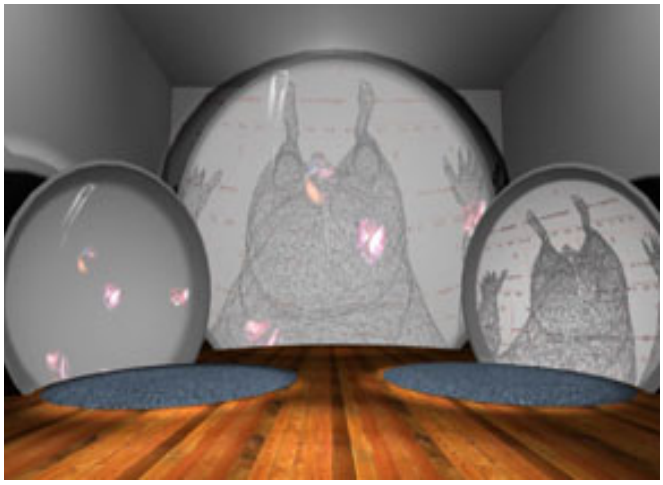
M3 T-Ggarden
Courtesy Sponge/M.Kuzmanovic

In Lichty, et al's *GRID* installations[30], the architectural space is transformed though sound and video into a space for communication, play, and collaboration as the participants work together to shape a transparent sonic environment. The environment can represent a stylized pastiche of actual contextually-based spaces or completely irreal environments, such as swimming as a peer in a school of whales. Technology is now transparent as all tracking is done through embedded sensors throughout the space, and hints at ubiquitous interfaces, which can then be used to represent infosets, whether virtual or cybrid in architectural structures. The end goal to *The Grid* is an interactive architectural space in which the participants can shape the audio, visual and possibly even structural components to respond to the group's collective actions. In the case of *The Grid*, the embodiment of the informational body has become both transparent and collective, as the installation itself is now the display and the interface, and the bodies performing within it are as inscribed by the reactions of the installation as they inscribe upon the piece. .

A further extension of the embodiment of experience through its inscription into technologically ubiquitous spaces is when an autopoetic element is incorporated into the environment

The last two instances highlight spaces where the responsive element has some sort of direct correlation to the actions of the visitor, whether it is representational in nature or not. A further extension of the embodiment of experience through its inscription into technologically ubiquitous spaces is when an autopoetic element is incorporated into the environment. This breaks the direct representational linkage between body, action and space, and creates a milieu in which the informatic corpus as aesthetic dataspace exhibits limited autonomy as it performs with the audience. In a proposed work, *Space Without Organs* (Lichty & Little)[31], the bodies of the participants are remapped back upon the space through projections of dataset representations of 3-dimensional bodies, organs, and internal sounds of the human anatomy across three responsive areas in a room. In the piece, two virtual worlds, one 2D, one 3D, are linked where the participants generate sets of metaphorical bodies and organs that are then mixed in real time as projections in the installation space to infer a reflexive inscription of the space by the very bodies that are within the technological space itself. In addition, a central GRID senses the actions from both worlds, senses the motion of participants within the gallery area, and creates audiovisual responses and builds cumulative datasets from the worlds' interactors. Such installations

The GRID (3d representation)
Courtesy Patrick Lichty



Space Without Organs (3d representation)
Courtesy Patrick Lichty/Gregory Little

..it appears that in a culture of technological ubiquity there will be numerous levels of engagement with the subject

create a metaphorical translation of signs that infers a series of semotic recursions between the body and its environment when responsive spaces become transparent. Furthermore, the inclusion of a cumulative element adds the possibility of a work self-generating its own body of information, which can become a collaborator in a performative aspect of the installation itself.

Conclusion

Throughout this discussion I have looked at the possible interstices in the emerging digital society that could be utilized for transmission of aesthetic content in a possible culture of technological ubiquity. From the ever-present screen throughout the various technological devices and methodologies to the disappearance of the interface in space itself, it appears that in such a culture there will be numerous levels of engagement with the subject. And, as such, an ecology of devices and systems can emerge that the artist can utilize for the transmission of their message. In each case, the mode of expression is linked to the embodiment of the information and its forms of representation (screen, hand, body, space), and this will in part define the scope and context of the artistic intervention that the practitioner will create. The aesthetic/epistemological concerns of the conceptual context of the work will be likewise tied to the representations of the space of interaction and response with the individual or group. These factors define how a culture of technological ubiquity may build its infrastructure, but it does not foresee the interstitial crevices that the artist my exploit for their aesthetic purposes. As with most applications of new devices throughout history, the trend has held true that a given technology is frequently used for radically different uses than first intended. The artist, through critical inquiry and diligence, will likely be the first to find the niches and cubbyholes in the expanding global networks. Dietz' appeal to the creative to fashion the artistic blueprint of the coming age is a call to practitioners of all disciplines to consider the cultural dimensions of the digital society. Our culture is a key reflection of our own society, and through the study of this series of works, it is my hope that I have made visible some of the underlying issues and structures that could be utilized to build a coherent culture of technological ubiquity.

References

[1] Lichty, Patrick. *The next "Little" Thing: Small platform installation and new media art*, 1999, Presentation at Invencao 1999, Itau Cultural Center, Sao Paulo, Brazil.
[2] Anders, Peter. *Envisioning Cyberspace*, 1998, McGraw Hill, New York, NY - Anders uses the term 'cybrid' throughhie text to connte space in which virtual and physical spaces exist concurrently to the user. Augmented reality is an example of this concept, but is only one possibility of a cybrid space.
[3] In my involvement in technological art since 1978, it has taken until 2000 for institutions like the Whitney to include predominantly technological art forms like Internet art in their Biennial. Furthermore, the lack of a material referent for archival and objectification once again problematizes the institutional acceptance of these forms.
[4] Dietz, Steve. Introduction for Mitchel Resnick's "Perpetual Kindergarten" lecture, *What's Next Lecture Series*, 1999, Walker Art Center, Minneapolis, Minnesota, USA
[5] Stephenson, Neal *The Diamond Age*, 1995, Bantam Books, New York City, USA
[6] Hayles, N. Katherine *How We Became Posthuman*, pp.28, 1999, Univ of Chicago Press, Chicago, Illinois, USA
[7] The various disciplinary inquiries called forth by considering computer culture are vast, and far beyond the scope of this paper.
[8] Roland Barthes. "The Death of the Author." *Image, Music, Text*. Ed. and trans. Stephen Heath. New York: Hill, 1977.
[9] Case, Sue-Ellen. "Performing Lesbian in the Space of Technology: Part I." *Theatre Journal* (March 1995), 47(1):2, pp. 5-10
[10] Nintendo GameBoy, http://www.nintendo.com/gb/index.html
[11] As of 9/2000, I have only seen a mention on the Rhizome list of a PalmPilot-based poetry project and talk of utilization of WAP-based cellular phones. No other references are known to the author.
[12] On a recent trip to one of the local office supplu superstores, I noticed a PDA-style information appliance that centered around the playing of GameBoy-

style games and sharing of notes between owners. The television ads consistently showed teenage girls using them, which is an interesting shift in demographic focus from the usual male audience. Unfortunately I do not remember the brand of the device.
[13] Cole, Didymus, Lichty, et al. *Sseyo Concept Phone* http://www.sseyo.com, 2000
[14] Lichty, Patrick *Alpha Revisionist Manifesto* 2000
[15] Penny, Simon/Schulte, Jamieson, *Sympathetic Sentience*, 1999, *Digital Traces,* Pittsburgh Center for the Arts, Pittsburgh, PA http://www.pghcenarts.net/digitaltraces/index.htm
[16] [17] LEGO Mindstorms Robotics System http://www.legomindstorms.com
[18] Mitchel Resnick, Home Page, http://lcs.www.media.mit.edu/people/mres/
[19] Shown at Resnick's presentation at the Walker Art Center's *What's Next* lecture series, March 1999
[20] Lanier, Jaron. Keynote lecture at Arts & Technology copnference, University of Maryland College Park Center for Baroque and Reanaissance Studies, Oct. 1998
[21] Both Katherine Hayles in *How We Became Posthuman* Laurie Anderson in *The Ugly One With the Jewels* and Gregory Little in his *Bodies Without Organs* project muse over the similarities between the similarities of bodies of text (books) and bodies as text.
[22] I posit throughout much of my writing that we communicate on concurrent channels in person and when we create media, this may consist of various gestures, body languages, subtexts, or concurrent media texts.
[23] Lichty Patrick. *Internal Monologues Project*. 1998-
[24] MIT Wearable Computing Group, http://mevard.www.media.mit.edu/projects/wearables/
[25] La Porta, Tina. *Call and Response* Performance The Kitchen, New York New York, USA. 9/26/2000, 7:30 PM.
[26] *Augmented Groove*. Ivan Poupyrev et al, ATR Research Labs, Kyoto, Japan http://www.mic.atr.co.jp/sspace/
[27] *M3 TeaGarden* http://www.deepfoam.org/sponge/tg_siggraph/sig_html/play.html
[28] From personal correspondance from M. Kuzmanovic
[29] Ibid.
[30] Patrick Lichty *The Grid*, http://www.voyd.com/grid
[31] P Lichty/ G. Little, *Space without Organs* current reference at: http://www.voyd.com/grid .