THE HOME TEAM ENVISIONED A DOORKNOB DESIGNED TO CAPTURE THE SPIRIT OF ONE'S HOME BY COLLECTING INFORMATION, SUCH AS AN INVENTORY OF ITS CONTENTS, THE VIEW FROM A WINDOW OR NOTES AND STORIES CHRONICLED BY ITS OCCUPANTS. THE DOORKNOB COULD ALSO COLLECT DATA AUTOMATICALLY, SUCH AS THE HISTORY OF A PARTICULAR OBJECT'S USE. THE DOORKNOB SHOWS THE POWER OF A NEW ECOLOGY OF THINGS TO REIMAGINE TRADITIONAL CONCEPTS SUCH AS "HOME" AND GIVE THEM NEW MEANING, AS CAPTURED IN THE ILLUSTRATION AT LEFT.

PROJECT TEAM: HOME_1; ANIMATION: SEBASTIAN BETTENCOURT

/models/

Philip van Allen / A new era of technology

integration is emerging that will provide unique affordances and capabilities different from those of today's computers and gadgets. What will this new system be like? How will it work? How can we create a system that has an open character, and permits people to adapt it to their own needs? And how we can design it to be resistant to privacy invasions, yet capable of rich exchange? How, then, can we use design to benefit people in the most interesting ways?

The guiding concepts and models used to drive the design and implementation of ubiquitous computing and its technology infrastructure and associated applications will largely determine its character. RFIDs, smart sensors, back-end servers and wireless access to information everywhere are only the technology components of a system. How these are integrated with each other, what form they take, what and where the human interface is, and who controls their capabilities, behavior and information content is still to be determined.

The Internet is an instructive case study for how a good model benefited an emerging medium. The strong vision and guiding concepts defined by ARPA (later renamed DARPA – Defense Advanced Research Projects Agency) with its contractors the Rand Corporation and BBN Technologies formed an open platform that has accommodated many productive uses that were completely unanticipated when the Internet was created.

While driven by Cold War concerns of survivable operations in the case of a nuclear attack, the radical model (especially for a centralized command-and-control military) of a decentralized network where information is broken down and passed around using open standards has turned out to be incredibly robust and useful. The model created the opportunity for applications that include email, the Web, Internet telephony and self-published video, all running on a system design whose basic philosophy was established in the 1960s. The productiveness of the system grows directly out of the model defined and defended by the Internet's founders.

So now, in the early days of the 21st century, we are at a moment when designers, engineers and, I hope, the public, have an opportunity and the responsibility to define beneficial models for an emerging new medium of technologies integrated into everyday things. Will it have the open and productive character of the Internet? Will it have the closed, centrally controlled model of cable TV? Or are there other models for this new medium?

For an understanding of possible directions, we can look at some of the visions given to this new infrastructure. Proposed models include those designated by a variety of terms, including ubiquitous computing, ambient intelligence, everyware, sensor networks, the Internet of Things, and our term, the New Ecology of Things.

Ubiquitous Computing

The late Mark Weiser and others at Xerox's Palo Alto Research Center (PARC) developed the idea of ubiquitous computing. This, and its cousin pervasive computing, implies a computationally focused system that is ambient, silent, invisible, everywhere. Ubiquitous and pervasive computing systems are hidden in the background and provide many automated features and services. Adam Greenfield shows us some examples of how this model plays out in his book *Everyware: The Dawning Age of Ubiquitous Computing*:

> By entering a room, you trigger a cascade of responses on the part of embedded systems around you. Sensors in the flooring register your presence, your needs are inferred (from the time of day, the presence of others, or even the state of your body), and conditions in the room alter accordingly.

And later:

> Speech, too, carries clear cues as to the speaker's emotional state; a household system might react to these alongside whatever content is expressed – yes, the volume can be turned down in response to your command, but should the timbre of your voice indicate that stress and not loudness is the real issue, maybe the ambient lighting is softened as well.

In this view, embedded systems use complex rules to behave without intervention. The systems sense characteristics of people and the environment, infer needs and make automated decisions that cause changes in the world, turning on lights, collecting and presenting information, or purchasing products and services.

While the automatic accommodation of all our needs seems seductive, there are some questionable assumptions in this approach. First is the idea that systems can always be smart and helpful enough that people won't need to participate in the decision-making process. This idea has been around for a long time, in visions of the house of the future, for example, where refrigerators automatically buy groceries as needed, and, as in Greenfield's scenarios, environmental controls that adjust to our moods and make us happier. This position has a kind of utopian optimism similar to the early days of the Web, when people believed, for example, that brick and mortar retail stores would be eliminated by online shopping, and loneliness would be dissolved through virtual communities.

The disappointing history of artificial intelligence tells us that ubicomp systems may never be very sophisticated in their ability to understand the intentions, meanings, emotions and desires inherent in the ambiguous, everyday actions and speech of people in homes, public spaces and

THE SOCIAL TEAM'S "LINKSTIR" PROJECT IMAGINED PAIRS OF SPECTACLES THAT ALLOWED VIEWERS TO SEE STRANDS OF LIGHT BETWEEN THINGS IN THE ENVIRONMENT, INCLUDING OBJECTS AND PEOPLE. THIS CITYSCAPE SHOWS HOW THE CONCEPT WORKS ON THE STREET. THE DIFFERENT COLORS INDICATE DIFFERENT RELATIONSHIPS IN THE AUGMENTED REALITY SYSTEM.

PHOTOMONTAGE: SEBASTIAN BETTENCOURT; PROJECT TEAM: SOCIAL_1

work settings. But more importantly, do people really want this kind of automation? For example, do you want a system deciding what should happen when you are stressed? One day, you may want to hear the band Zero 7 to relax. Another day, you may decide you want to listen to Metallica. Or one week you may want to buy strawberries because they are locally in season, and the next you may want imported peaches for a special occasion. In human terms, will it be very satisfying or useful to have your stereo or refrigerator automatically make your music or food choices?

People often decide what they want by exploring possibilities, learning as they go. We like options, and often make new discoveries by trying out different things and taking advantage of serendipity. The model of ubiquitous computing assumes that the "right" outcomes can be determined in advance, and decisions logically flow from assumptions. But in the real world we want more flexibility. The invisible, ambient character of ubicomp does not provide the affordances or openness that encourage or even accommodate a lively sense of discovery and productive, meaningful creation. Where are the choices and the interfaces for them?

This idea of "right" outcomes raises further questions. Who controls how these systems make their decisions? How do we influence the algorithms and assumptions? Will our "computationally enhanced" lives be dominated by organizations like our cable companies who limit our lives to four or five demographically optimized packages? It's one thing to have TV channels packaged, but imagine living with a pervasive home-automation system that's programmed and managed by Comcast or Clear Channel. With a model such as ubiquitous computing where the system exists under the surface of life, what openness and user agency is lost? Do our lives become centrally controlled, over-systematized and predictable? What values are emphasized or suppressed?

The Internet of Things

Coined at MIT and expanded on by Bruce Sterling and others, the Internet of Things takes a different approach. The model sees the world as an open network of independent objects with no central control. Things will

sense and log what's going on in themselves and the world, act on their own, intercommunicate and exchange information. It is not unlike the current blogosphere, except the blogging is by and about things.

Like the current Internet, the emphasis is on decentralized communication among objects where humans browse the databases (blogs) built up around a set of collected objects. There are massive interconnections among things – things blog about themselves, about other things and about people. And people blog about things as well. Every *thing* has an info-sphere swirling around it, accessible to every other *thing* (and every*one*) else.

The Internet of Things implies the virtuality of the Internet, where the information and content is represented as an abstract space, independent of the things (i.e., my computer screen is a window into this abstract space, and it doesn't matter where the things and their content live or where I am – I can search, organize and operate on this abstracted "information" to solve my problems or be entertained). As we've seen from the Web, this is incredibly powerful. Yet this model ignores the very characteristics that make *things* different from the Internet's anonymous servers, Web browsing, virtual representations and *ether*-net.

The computational activation of objects and spaces is interesting exactly because of the anti-virtuality of things. *Things* are tangible, manipulable and sense-able, and they exist in real space. Treating them purely as virtual information generators and virtual representations of themselves drains them of their power as things in space. The Internet of Things model makes the mistake of applying a successful model to a new medium, just as traditional publishing, entertainment and advertising models were initially, and wrongly, applied to the Internet. Here, the Internet of Things leaves out direct human interaction and benefits of life *off-line*, *on-ground*, *in-space*.

The New Ecology of Things

I propose a new model that strives for a designed and coherent approach to this emerging medium. The New Ecology of Things is not under the surface like the ubiquitous model, nor is it focused on the virtual like the Internet of Things. Instead, I envision a rich world full of activated things that are exposed and accessible, and which use the affordances of tangible things and inhabitable spaces.

The idea uses the metaphors of natural ecologies and human mythologies. In this decentralized model, activated objects and spaces form an emergent ecosystem where each thing is both independent and interdependent. Things establish ongoing relationships with everything else in their environment, including people. Things have particular behaviors and have tangible, embodied and exposed local modes of communication and interface. And as part of a human ecosystem, things may also seem to have magical qualities, and acquire meaningful stories and even mythologies significant to their owners. The New Ecology of Things is a

model that implies an organic, evolving system influenced by the actions of its inhabitants (both people and things) and the circumstances of its environment.

Let's revisit the world that Adam Greenfield described, but reworked using the model of the New Ecology of Things.

A NET Story

After an annoying lunch meeting, you arrive home and enter your living room – nothing much happens. You notice that the thermostat is unobtrusively glowing in its alert mode (you chose a polka dot pattern for this). As you approach, it recognizes you (i.e. one of its owners), and switches its display from the current temperature to a list of status reports and options for what to do (it seems the air filter needs changing, and the thermostat offers several places from which to order one). You ignore these, and instead grab an old Illy coffee can that you've trained to be a remote control (after activating it with a simple NET sticker). Turning the can on a particular side, the blinds open and the lights turn off, giving the room the diffuse light of a foggy afternoon. The can/remote burbles softly once everything is set, letting you know it's finished.

Sitting down on your couch, you pick up one of several stones on the coffee table. This particular stone came from a memorable camping trip to Joshua Tree, and over the years it has become smooth from rubbing. You set it back down, and the table surface activates as a display and begins to surround the stone with images and text. Since this is your journaling stone, you begin compiling an entry with reflections from the last few days. Putting your camera phone and the book you've been reading near the stone, images from the phone and text from the book appear on the table. Journaling progresses as a process of mixing and arranging photos, quotes from the book and your own writing as they array on the table surface display. Occasionally, the stone unobtrusively displays earlier journal entries and other references that it finds have associations with your current entry.

Finished with that, you put the stone in your pocket for later, and to no one in particular, you say out loud, "What a week!" Noticing the stress in your voice, your partner comes in from the other room and says, "How are you doing?" The system does nothing.

Through this NET story I'm engaging in a bit of speculative design and demonstrating some of the differences of a NET-inspired approach. In this world, things and spaces are activated and aware of their surroundings, but they expose their actions and workings to people. Instead of making choices without intervention, they provide options. This is also a world designed by its owners, providing opportunities for people to customize things and create new functions in simple ways. The owners can take personally meaningful objects and give them powers, further enhancing the meaningfulness of the objects.

In the NET approach, one works with objects and spaces directly, in a tangible, embodied manner. Things behave in ways that seem integrated with their purpose and form or with human-applied associations and myths. While these things may operate autonomously, they communicate with people, indicate their intentions, and offer interfaces that allow people to make choices about the behavior, character and outcomes. They can be turned off.

Three emerging ideas inform the New Ecology of Things model, and give it a unique and distinctly human-centered focus as opposed to a computational- or network-centered focus. These ideas are Productive Interaction, Embodied Interaction and Mythological Interaction.

Productive Interaction

I developed the idea of Productive Interaction (and have written about it elsewhere – see productiveinteraction.com) in response to some limitations I've noticed in experience design. Productive Interaction shifts the emphasis of interaction design away from the notion of creating persuasive, consumptive, feel-good experiences for people, and moves it towards the design of content, contexts, affordances and interactions, creating an open mode of communication where people form their own outcomes and meanings. That is, we can design interactive systems that are stimulating and provocative, and have the capabilities for the production of new, personally significant meaning spaces. Interaction can be a dynamic communication medium, and need not be limited to goal-oriented tasks. By communication, I do not simply mean the transmission of "information." Rather, I mean a kind of communication that creates a journey of open-ended discovery for the user, sharing insights, dilemmas and questions, and creating opportunities for synthesis.

Productive interactions in the New Ecology of Things enable people to create something new for themselves rather than being limited to scripted options. For example, imagine this book reinvented as a series of small, block-like objects with simple interfaces. Placed on an interactive display surface, each object instantiates a topic in this display as text, video, audio, diagrams, etc., which the user can manipulate and remix. Perhaps in response to "reading" the book, users create a different model than the ones discussed. They would manipulate the "book" objects on the surface, grabbing aspects of NET, the Internet of Things, and perhaps adding ideas on sustainability from a different book's block. Reading, analyzing and "writing" can become an integrated, organic, responsive process where text, image and ideas are highlighted, juxtaposed, remixed and sometimes invented.

Similarly, in our NET story, *you* used a lighting setting you made. A calculated light setting was not imposed automatically because the system thought you were in a bad mood. Instead, the setting came from a productive interaction with the lighting system and a self-created remote control/coffee can. And note that you did not create the setting by sitting down at

a computer to program it. Instead, you adjusted the blinds and lights, and "trained" the coffee can by thumping it on the table a couple of times. This tangible interaction approach leads us to our next set of ideas.

Embodied Interaction

Paul Dourish (who has worked at PARC), in his book *Where the Action Is: The Foundations of Embodied Interaction*, discusses the rich physicality of things and the opportunities and benefits this affords. Specifically, he identifies two important areas: tangible and social computing. Tangibility allows people to take advantage of their natural abilities to understand and manipulate physical things that exist in the "real" world (for example, how a stone falls or spins on a flat surface). Social computing is Dourish's term, and refers to "the attempt to incorporate sociological understandings... [that] recognizes that the systems we use are embedded in systems of social meaning, fluid and negotiated between us and the other people around us." In this view, objects and spaces that have hidden or virtual interfaces instead of embodied, tangible interactions fail to make use of the essential human powers of manipulating objects and building social interactions in physical space.

Using the principle of embodied interaction, we can design our activated things with certain behaviors in the real world. The physicality and explicit behavior of things fit into a powerful behavior pattern for humans, who have a lifetime of experience and millions of years of genetic learning that informs our interactions with objects and spaces. People are incredibly good at operating in the physical world – looking, touching, analyzing, predicting, recognizing and manipulating. Pushing all that through the thin channel of a computer mouse and disembodied screen is a gross underutilization of human capabilities. So in the NET story, you work with objects that exist in space. To create a journal entry, you move your stone, camera-phone and book around to establish relationships among them. In a seamless crossing between the physical and virtual, digital objects such as photos and text are similarly treated in the coffee table display, being moved around on the surface as if they were objects.

The embodied interaction approach also fits more easily into our social systems. So, for example, in the NET story a visitor to your house would quickly learn how to set the lights, simply by watching you do it, and perhaps asking a question or two. The visitor could then pass on this knowledge to a third person, or adapt this knowledge and make a new lighting system for her own apartment. But why make a lighting control out of a coffee can? The New Ecology of Things allows us to customize our world with personally significant associations that add meaning beyond simple functionality. In this case, the coffee can becomes an activated part of our personal meaning system just as more passive objects such as artwork and photos do. We can look at this as a kind of mythological interaction.

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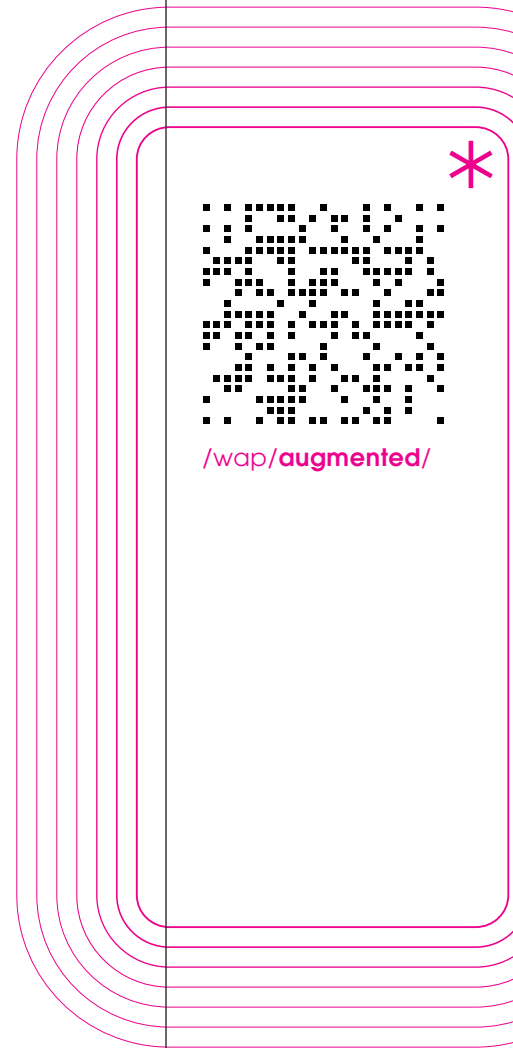
Mythological Interaction

Technology design is usually focused on products, solutions and experience. For example, the iPod and its integrated ecology of iTunes player and iTunes store are a great set of products for entertainment. But one hopes there is more to life and its design than entertainment, consumption and pleasure, and that design can create things that have a deeper significance to people. In Carl Jung's *Man and His Symbols*, M.-L. von Franz writes that

> the existence of human beings will never be satisfactorily explained in terms of isolated instincts or purposive mechanisms such as hunger, power, sex, survival, perpetuation of the species, and so on. That is, man's main purpose is not to eat, drink, etc., but to be human.

HACKING THE IDEA OF A TYPICAL PROJECT PRESENTATION COVERING THEIR RESEARCH, THE HACKERS TEAM TOOK THEIR AUDIENCE DOWN TO THE BASEMENT OF ART CENTER'S SOUTH CAMPUS INTO WHAT WAS A FORMER WORKOUT ROOM. AS SHOWN IN THE SEQUENCE AT LEFT, THEY INVITED EVERYONE TO WEAR MOTION-DETECTING SUN SPOTS ON THEIR WRISTS AND THEN TO PERFORM YOGA STRETCHES ON THE FLOOR. THE SUBSEQUENT MOVEMENTS OF THE PARTICIPANTS CHANGED THE SOUND AND SEQUENCE OF THE VIDEO PRESENTATION, WHICH WAS PROJECTED ONTO THE CEILING AND FLOOR. IN THIS CASE, A NEW ECOLOGY OF THINGS HELPED SHIFT TRADITIONAL ROLES, AND WHAT WERE ONCE PASSIVE OBSERVERS BECAME ACTIVE PARTICIPANTS.

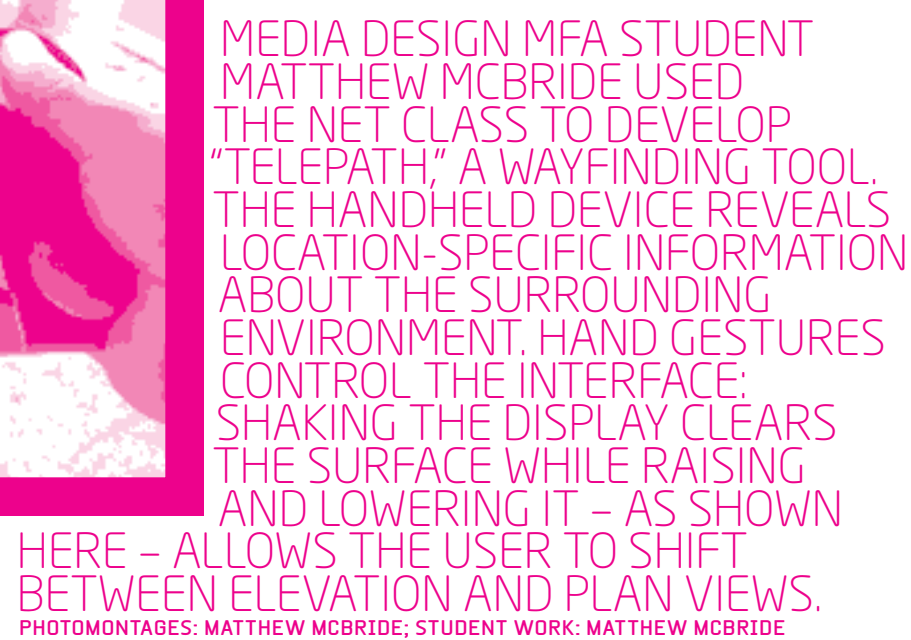PHOTOS: ADRIANA PARCERO; PROJECT TEAM: HACKER_1

One can debate the validity of Jungian archetypes and other specifics of myth-based theorizing, but the metaphorical and transcendent power of myths can provide guidance, emotional connection, modes of coping and stimulus for creative expression that more literal means cannot. That is, designers can look beyond the functional, efficient aspects of life towards a rich and complex side of being human.

Bronislaw Szerszynski, in his book *Nature, Technology and the Sacred*, concludes that we have arrived at a moment of the "contemporary, post-modern sacred" when we understand nature in both a scientific, rational way, right alongside a more transcendent, sacred view. I think this simultaneous, multiple view of the world also contributes to how we view our things, spaces and people, and leads to behaviors such as praying to the computer gods that our hard drive doesn't crash before a deadline or associating apocryphal stories with favorite mementos. In this way, myths help us cope with, and make practical sense of, the complex or unknown aspects of others, our world and ourselves. They may serve as practical tools, as when we produce and share mythologies such as how to beat the traffic. Myths can also serve the important and significant role of supporting creative and emotional purposes, by providing inspiration, guidance, provocation, comfort and vision. Put another way, myths are part of the poetic side of life, even though we are often discouraged from such poetic views. I believe this is a good time for designers to return to myth, or more accurately, to recognize, embrace and develop people's use of myth.

Perhaps we can move beyond the fetish allure of technology toward more integrated, complex and evocative applications of technology. In doing so, we can think past functionalism and leverage how people intuitively rely on mythic structures in new and interesting ways, building things that have a more personal, emotional and meaningful character and use.

As an ally and companion to myth, metaphor is a powerful consequence and tool of our embodied existence and fits in well with the embodied character of the New Ecology of Things. In his book, *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind*, George Lakoff discusses how this sense of metaphor seems to be inherent in how we think. For example, because we are embodied animals that have walked over hills, we make associations and metaphors such as "Pete Rose is over the hill," which uses the idea of a career as "a journey over a vertical extended landmark like a hill." We use the understanding of the world gained through everyday experience to generalize and extend ideas and experiences into new realms. Metaphor is fundamental to creativity and invention, and seems essential to meaningful and productive communication. Its application to activated things can extend them in new, less literal directions.

Conventional (i.e. not digitally enhanced) objects and spaces already afford the association of symbolism, mythologies and metaphors.

implications of pervasive computation and communications, and how can people best use, interact, customize and integrate a new medium?

The model of this new landscape is a critical step in shaping things to come. You may or may not agree with an ecological model based on productive, embodied and mythological interactions, but I hope that you will contribute to the design discussion by thinking critically about the models we've discussed, and perhaps enhancing them or designing your own models. This is the opportunity of this moment, to participate actively in the creation of a coming paradigm shift, and make it human-centered in a very deep and full way. It is a moment for thoughtful design and designers. END | NEXT⟶ 11

Activated objects and spaces can further amplify this possibility, creating the opportunities to associate our stories, metaphors and myths explicitly with them in a way that they can be shared by others, for example, as a kind of mythical tagging. Because the objects and spaces are digitally enhanced, we have new ways to tell stories, give things specific capabilities (not unlike how a wizard gives a sword magical powers), and use them in creative ways as both carriers and symbols of myth and metaphor.

In the NET story above, you turned a coffee can into a lighting control, perhaps in association with the idea of a morning ritual when one changes lighting, or perhaps to reflect the idea that coffee opens one's eyes to the light. Also in the story, you used a favorite stone as something that contains your thoughts and ideas for a journal. Similarly, in the first Home project in our NET course, the team came up with the idea of a doorknob that contains the essence of "Kami" or spirit of one's house. One uses the doorknob to re-create a sense of home wherever one is. In each of these cases, an association and mythology that has specific and important meaning for you informs the activated objects and spaces around you.

The Human Side of Design

One of the most important missions of the New Ecology of Things project is to consider the human side of design (versus the technical or commercial side) for the coming technology landscape. How do we want it to work? Who should control it? Who benefits from it? And what are the principles and goals that underlie it?

More specifically, NET establishes a framework for addressing some of the most challenging and complex possibilities of this new medium. What are the relationships between digital media and tactile objects and spaces? How can the design of systems grow beyond consumption and sensation, and move towards productive meaning generation? What are the relationships between the utilitarian and the poetic? What are the