Prototyping Speculative Objects for the Internet of Things

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Abstract
Digital media technologies allow the systems to be created that are rhetorical and create alternate values and experiences. Building objects that question these assumptions can help to reframe technological artifacts. Building inexpensive prototyping platforms that augment everyday objects in minimalist ways is a proposal for an alternative to existing, human-centered Internet of Things (IoT) devices. These platforms begin to move towards interactions among and between things as a bottom-up design study into ubiquitous small-scale computing and its aesthetic applications.

Author Keywords
Prototyping; making; materiality; Internet of Things; IoT; design

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces—prototyping; C.5.3 [Computer System Implementation]: Microcomputers—microprocessors; J.5 [Art and Humanities]—design

Background
I'm a PhD student in Digital Media at Georgia Tech's School of Literature, Media, and Communication. My research interests focus on developing systems that explore different kinds of interactions with technology,

attempting to create systems that are themselves ideological and that support particular kinds of aesthetic perspectives illustrating alternative values to existing, corporatist technological practices.

Broadly speaking, the framework that guides my research can be called *Critical Technical Practice* [1]. A critical technical practice operates simultaneously in two spheres: on the one hand producing technical work, but on the other taking that work and treating it as both a subject for criticism as well as a site for larger cultural critique. Building devices to up-end traditional understandings of device-making engages traditional engineering and art practice to produce real, functional objects: it attempts to transcend what's out there and postulates provocative new ways to get things done. At the same time, the assessment aspect of critical technical practice, where critical theory meets evaluation, hermeneutical implication, and personal experience, can be understood as a period of interpretation that informs later production.

Research Contexts

My approach to critical technical practice draws from three research contexts. First, Science and Technology Studies offer a historical, textual approach to understanding how meanings and uses of technologies are constructed socially. Pragmatist aesthetics in art and technology contexts [4,8] helps drive an understanding of the experience of interaction in itself.

Secondly, and contrasting with this user-based historical framing is an object-oriented approach to systems and things in themselves. Latour, for example, recasts the role of "inert" devices and systems as active participants in technological interactions [7]. Similarly, Bogost in *Alien Phenomenology* [3] seeks to flesh out a new ontological understanding of the world without humans at the center.

Finally, HCI-oriented design practices help to ground these theoretical framings and approaches in physical production. The critical design work of Bill Gaver, Tony Dunne and Fiona Raby are particularly inspirational to me, as they meld physical explorations of form and other tangible qualities with interventions in domains that hadn't previously been considered HCI. Bill Gaver's Prayer Companion, for example [6], offers a technical complement to the religious practices of cloistered nuns. Dunne and Raby's work from *Design Noir* [5] shows us a product line of furniture that is both sensitive to electromagnetic waves as well as unusually perceptive: a GPS Table that claims that it is 'lost' when it can't find a signal, or a table studded with compasses that reacts to electronic objects placed on it.

Prototyping the Internet of Things

"The Internet of Things" describes a trend advocating that all sorts of physical artifacts become connected to and controllable from the Internet. According to the Internet of Things (IoT) vision, a coffeepot might be controlled alongside a thermostat to have a home warm and the coffee on when a person wakes up; or sensors in the basement might email you if your basement is flooding. While this all seems very sanguine, current IoT technologies rely on centralized servers, well-defined APIs, and black-boxed electronics for the end-user, and are built only to be used in specific, condoned ways.

My project is to develop small, low cost, low-power, prototyping platforms to try to solve problems in

everyday life. These systems offer very little: they have four bits of input and output, no analog capability, and must be programmed in assembly. While the assumption might be that these devices are hard to use, the simplicity of the chip and its low capability means that for any number of applications, a solution can be cobbled together quickly: has the mail been delivered? Do I need to cut my lawn? Is there a slot available at that bike rack? Unlike more complicated and expensive platforms like the Raspberry Pi and the Arduino (each approximately 7-10 times more costly than the current system), this prototyping platform is built to explore the possibilities, both aesthetic and prosaic, of ubiquitous minimalist computing.

The Internet of Things without the Internet

I'm using these prototypes begin to sketch out an alternative vision of the Internet of Things. This IoT is bottom-up rather than centrally controlled; it emphasizing material/computational/ human collaboration rather than the parameterization of the everyday world from a central authority, and most notably, does not require the Internet. I intend to construct devices for small-scale, human-evaluated interactions between things; or more complicated, communication-driven emergent interactions that still requires humans for assessment. In these concepts, the system's output stays *in situ*, and people around them draw any relevant conclusions for themselves.

At one end of the project, I've designed boards based on baseline PIC parts using techniques from embedded computing. At the other end of the project, it's been my responsibility to imagine use cases, sensing techniques and cultural contexts for these devices, to create design fictions [2] that consider everyday objects as having interior lives that can be addressed and represented algorithmically. In creating a platform that has relevance to human and systemic actors, we're enforcing a particular algorithmic perspective on fundamentally analog or non-digital problems.

The lower cost that comes with using very simple hardware is a huge benefit. It becomes much more feasible to create many different kinds of smart things, with little regard to whether adding a microcontroller to something makes sense in the short term. It will be possible to build infrastructure-less sensing devices that become cheap, ubiquitous, computational material objects—from a spoon that tells you when your soup is cool enough to consume, to postboxes that make it clear the letter carrier has been by. At that point, we will find ourselves in a situation where the experiences that everyday objects have are translated only partially to the language of the observer. In some ways the simplicity of the IoT prototyping platform preserves the original promise of Mark Weiser's vision for ubiquitous computing [9]. These small computational artifacts instrument everyday materials, letting them become equal partners in ubiquitous meaning-making.

While prototyping, I've had to take a new look at how people live: what simple, measurable opportunities exist that could become a site for intervention or problem solving. To that end, one unforeseen outcome of developing a platform like this is enforcing a kind of "algorithmic lifestyle" on a prospective user. This has led to a set of research questions around constructing a speculative IoT: What parts of experience can be offloaded into a device? How can we support novelty, play, and other kinds of emergent aesthetic experiences while also supporting effective, useful

applications and allowing for satisfying material interactions?

Intentions for the DIS Doctoral Colloquium

The DIS Doctoral Consortium offers an exciting opportunity to meet, share ideas with, and collaborate with other researchers who are operating on different subjects from a similar perspective. I struggle with questions around evaluation and impact. How can we evaluate and create impact from speculative design systems? Can they affect mainstream technological production in worthwhile ways? Interacting with peers undergoing analogous struggles with their own research and production processes will be very helpful in terms of framing my own interests in the Internet of Things and its discontents.

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