

# Reflecting on Tangible User Interfaces: Three Issues Concerning Domestic Technology

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## INTRODUCTION

As tangible interface design continues to gain currency within the mainstream HCI community and further manifests within the space of consumer electronics how will its impact be realized and how as designers of new technologies can we shape that impact? In this paper we examine the question of choice in technology design from the perspective of the social sciences and then reflect on ways that TUI designers could use these insights within their own practices.

Of particular interest to this work is the repurposing and transplantation of current technologies into the domestic environment. The home has been a focus for much of the new work in HCI and in the near future we will see a continuation and increase in the development of domestic technologies. Much of the current work developing connected homes and ubiquitous systems for domestic use is compelling, though it seems to run directly counter to insights gained from the social sciences and philosophy of technology. In particular computer scientists, designers, anthropologists, and historians all offer very different points of departure concerning commercialization of domestic space and privacy versus data sharing. These differences may indicate a fertile area for research.

We've identified three issues for domestic technology design: 1) context and the differentiation of constraints, 2) the privatization of space, and 3) the perception of control. These issues are not original to this work, nor are they exhaustive. Our work here is to discuss them within the context of tangible interface and domestic technology design as a means for critical reflection.

## CHOICE IN TECHNOLOGY DESIGN

What is the importance of designing new technologies within a clearly defined framework or constraint system? Does technology not progress along its own path, one design being replaced by another that does the job better according to simple metrics? Let's look at the question of choice as it applies to the field of HCI. Our research is inspired by the work of humanist theorists in the domain of Science and Technology Studies (STS), and in particular the philosopher of technology Andrew Feenberg [15]. Drawing on the work of two generations of critical theorists and philosophers such as Heidegger, Marcuse, Marx, de

Certeau, Weber, and Habermas (among others) Feenberg has spent the last decade developing a critical theory of technology.

*"Feenberg's central point is that technology can only be misconstrued as an autonomous-rationalizing force if the contingency evidenced at the micro-level of design is ignored . . . there is actually no "essence" of technology."* [32, p.xiii]

Feenberg examines in detail the fetishizing of technoscience and explains how it is incorrect to believe that technological progress proceeds one-dimensionally. He shows that technology is not ahistorical, that it is in fact a part of our social matrix and that choices made in the design of new technologies are influenced by social and political factors. Calling technology ambivalent but not neutral, Feenberg elucidates a democratic rationality where individuals can shape technology and build an alternate modernity. This means that as designers we are not constrained by incontrovertible laws such as efficiency or a natural technical progression. For many of us this is not news; there have been fantastic examples of alternative technologies [9, 13]. One interpretation of Feenberg's work is that as designers of new technologies it is up to us to build the world that we want to live in and not accept the often-unexamined constraints of dominant sociopolitical frameworks.

STS is primarily an analytical field, but examples of alternately structured technology development that references the knowledge and techniques from STS may be found in the realms of design, art, and the HCI community. The design team of Fiona Raby and Tony Dunne have developed technologies that question the basic tenets of design and engineering—that products should make people's lives better. By acknowledging that products (automobiles, fast food) often do not enrich lives but often complicate them, Dunne & Raby have freed themselves to design appliances, furniture, and architecture that they claim resembles film noir rather than a typically cheerful, resolved Hollywood blockbuster [12]. The Computing Culture Group at the MIT Media Lab actively developed techniques to defamiliarize and reveal tropes of technology development, borrowing from artistic and counter-cultural practices like the situationists' detournement. Projects have focused on personal and political reinterpretations of

technology, from regenerated home appliances [9] to technologies that renegotiate the relationship of the public to the government [16] and the US Department of Defense [1].

Phoebe Sengers and the Culturally Embedded Computing Group at Cornell have also developed computational systems that integrate knowledge from STS. Building on Phil Agre's Critical Technical Practice [2], a work that binds critical reflection with technology development within the field of AI, Sengers presents the idea of Reflective Design.

*"Drawing on existing critical approaches in computing, we argue that reflection on unconscious values embedded in computing and the practices that it supports can and should be a core principle of technology design."* [30]

### REFLECTING ON TANGIBLE USER INTERFACES

As researchers we are well situated to avoid the mistakes of previous generations and to benefit from the lessons of critical theory and the social sciences—TUI is still a nascent technology and it is up to us to decide where to take it. The conceptual groundwork has been laid [21], and frameworks have been written [31, 19] but we have a long way to go still. At the first conference dedicated to tangible interaction<sup>1</sup> it became strikingly clear that our field is wide and inclusive. Papers were presented on topics ranging from display actuation [25] to dance and movement [23].

Tangible interaction brings digital objects into the sphere of natural life. We have evolved over millions of years to be expert at manipulating complex objects with our hands and cognition has been shown to be more than a closed process within non-spatial minds [18, 26]. Those of us in the field, along with many others, are aware of the tremendous value available here, but much of the insight gleaned from the last ten years of work has yet to spread beyond the lab. While we are still shaping the work that will soon filter out into the world at large it is imperative that we not only identify what makes TUI valuable but also how we will measure that value. As evidenced from the growing body of TUI literature the relatively impoverished metrics that have been guiding HCI development for decades, such as speed and efficiency, are not of primary concern anymore. TUI researchers are more interested in things like aesthetics, materials, emotion, cognition, and innovation. Critical reflection should be added to this list; otherwise we run the risk of reproducing many of the standard "occupational hazards"—mistakes technologists often make, such as 1) reifying a skill or ability that users already have as a new

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<sup>1</sup> The First International Conference on Tangible and Embedded Interaction held in Baton Rouge Louisiana in February of 2007, a few weeks prior to the writing of this paper. <http://www.tei-conf.org>

technology, 2) offering systems that serve the interests of inventors or distributors more than users, and 3) giving people a technology that solves one problem that then creates more problems.

### THREE ISSUES FOR DOMESTIC TECHNOLOGY DESIGN

#### Context and the Differentiation of Constraints

Understanding the use context for tangible interface design is an essential precursor to critical reflection. As one reviewer of this paper pointed out, context is of increasing importance in HCI [11]. For most members of industrialized society there is a large difference between the practice of working and the practice of living. Features and systems that are identified as acceptable or even beneficial in one frame of existence could be just the opposite in the other. This difference is often subtle and difficult to categorize, e.g. setting up a computer to serve music to a living room stereo could easily be seen as work. Living can happen in many spaces, but domestic space is usually understood as a space of personal or familial control. While there are exceptions, such as home offices in developed countries, and home factories or production spaces in developing ones, such spaces are often in direct contrast to living rooms and kitchens. Work space and home space are roughly coded with the two major non-military themes of contemporary technology: productivity and entertainment. As technology pushes further into all reaches of our lives an understanding of the differentiation between these two realms gains relevance—many of the interfaces and systems designed for personal use, the home, or other non-work applications are directly ported from the office paradigm. The workplace has been the crucible for forming many of our current technologies [3].

The formal boundaries between work and living have begun to erode; we work from home and the road, and we "hang out" at work. An exhaustive description of such changes in social structure—let alone their variability by class, age, or geographic location—is beyond the scope of this work; here we will focus on the home and the ways in which new technologies designed for home use should be informed by critical reflection.

In examining the home as an environment for new technology we must look back to the history of the home. This paper is not an attempt at a comprehensive exploration of the meaning of home or of technologies in the home, for a deeper analysis see Ruth Schwartz Cowan's *More Work For Mother* [7]. Cowan reveals some interesting differences between technology for housework<sup>2</sup> and other forms of labor. She points out that housework has been *incompletely industrialized* [7, p.7]. Our societies have not "outsourced" cooking dinners to factories to the same degree as they have

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<sup>2</sup> *More Work for Mother* is a great resource for discussion of gender issues in technology, for more on this see Haraway 1991 [17].

garment manufacture or vegetable and livestock production, goods once primarily produced in the home—yet much housework is dependent on infrastructures such as the electrical and sewage systems.

Where new technologies have been introduced into the home the results have not always been as expected. Although automatic washing machines were introduced in the first half of last century as labor saving devices evidence has shown that they are better described as labor changing; that they increase the amount of work done by making it easier to do and by changing the perception of hygiene [27]. This argument could be easily modified to examine email and the way in which a system that makes sending letters easier and faster increases the time spent on the activity in the whole rather than reducing it.

It would be easy to see the washing machine's actual role in changing and increasing work as an "unpredictable technological side effect," if increasing the work done by an employee per hour weren't a cardinal way by which managers increase profitability. It is not surprising that industry's solution to industrializing a domestic activity would transform labor in a way that traditionally benefits industry. The very idea of a "labor saving" device (a central narrative for selling white goods) ports language from the industrial plant to the home kitchen, and the introduction of the electric washing machine at the beginning of the century predated lobbying by the women's movement to recognize domestic labor as legitimate economic activity by nearly sixty years.

### **The Privatization of Space**

A number of authors have pointed out other unexpected consequences of our new technologies [4, 5, 6, 14, 28, 29]. Of significant importance to the domestic environment is the privatization of space [4]. Computers, music players, televisions, and other devices often isolate individuals and remove them from the shared spaces within the home and their local communities.

*"The home appliances of the twentieth century have offered technological, rather than social, solutions to problems of shared space . . . [they] all privatise space."* [4]

Privatization of space is part of a longer western trend towards larger living spaces and more individual rooms, but the single electronic technology that has had the most profound effect on space and time in the home is the television. The television consumes over four hours per day of the average American, and introduces tremendous amounts of information and corporate interests to into the domestic space. Nonetheless, it is typically a communal activity and a shared experience.

In the west it is now very common to see friends or family sitting in the living room together, each with their own laptop. Each member of a group such as this may be interacting within other social groups spread over the globe via instant messenger, message boards, forums, or social

networking sites. While on the one hand these technologies have created new opportunities for communication and community building that are strengthened by shifting time and space over the Internet, on the other hand they are ambivalent with regards to co-located relationships, i.e. the other people sitting in the same room with you. The individual screens draw in one's attention, removing the user from shared physical space and altering the domestic environment in unplanned ways. TUI can proactively avoid the physical and mental passivity of screen based interactions and work to increase socialization and connection between household members while continuing to offer the advantages for remote social networking allowed by screen-based information technologies.

### **The Perception of Control**

Workers understand that the systems and practices in their specific work environments require expertise; conformation to larger business practices is taken for granted. This is not so in the home. The home is the place where we decide how things should be and where we express our individuality. Csikszentmihalyi and Rochberg-Halton describe how people come to develop relationships with their personal objects in the home and how each of us forms these relationships, a process they refer to as cultivation, through social processes and beliefs [8]. This process requires the investment of psychic energy into our environments through a process of understanding our objects and our goals. When technology in the home is designed without room for appropriation by users this process is cut off and negative relationships develop. This is especially true for poorly designed interfaces as shown by Norman [24].

Poorly designed interfaces teach people that they are helpless to control their objects. This type of learned helplessness can also result from context aware systems and automations where the internal machinations of a device are invisible to users and must work perfectly or else fail completely [14]. Ellen Langer and Judith Rodin's work, situated in a non-domestic living space, reveals the negative health effects of a lack of perceived control [22]. In their study nursing home patients who did not experience a perception of control in their lives died significantly earlier than those who did. These findings might be especially fatal as nursing homes can be extremely disempowering, but we anticipate that it will have importance in domestic spaces as well. Stephen Intille has addressed this problem with the work at House\_n [20] where they seek to make smarter individuals rather than smarter homes.

### **CONCLUSION**

The rules have changed for technologists in the twenty-first century. The question is no longer *what can we make*, but *what should we make*. It is difficult to know ahead of time what the real world effects of a given technology will be [5], but by using the tools of critical reflection and heeding insights from the social sciences we will be better equipped to answer the big questions.

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