Digital Simplicity: Usable Personal Ubicomp

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There are many indicators to suggest that Americans feel technology is complicating their lives. These range from the growing strength of the voluntary simplicity movement [Elgin 1998] and the slew of popular books on "unplugging" [Brende 2004] to research showing that many consumers are overwhelmed by the increasing complexity of daily living [Breen-Pierce & Robin 2000]. In response, many individuals chose to selectively reject certain computing and communications technologies. For example, some people choose to not receive their work email at home, while others deliberately turn off their cell phones outside of work hours. Many have bought PDAs and simply don't use them anymore. A clear value proposition, the support of an important cultural or social experience, and a straight forward user interface are all important components of successful technologies.

One can view the current slow growth of PC penetration into American homes (3-4%/year) beyond the current installed base (75%) as an indication of PCs not having a high enough value proposition for the remaining 25% of homes to take the plunge. This slow growth is only partially explained by economics and the "digital divide." Some of it seems to be purely a rejection of the complexity that these devices introduce without a corresponding positive value or social experience. The prevalence of expensive home entertainment equipment and services (e.g., multiple televisions, cable TV, VCRs, and DVD players) in even relatively low income homes highlights the impoverished value propositions presented by existing computing technologies.

Current research in ubiquitous computing has a tendency to fall into a similar trap. Not only does such research seem driven by an underlying belief that technology qua technology is a value proposition, but developers of these technologies ask their imagined customers to make a Faustian bargain: "take this complex technology into your personal life and you will now be able to do these new functions: A, B, & C." The Digital Simplicity project has a different premise – technology can be simple, easy-to-use, and still have powerful impact. Instead, this project tries to offer a different value proposition: "take this simple technology into your personal life and we will make the activities D, E, &, F you are currently doing easier." In this paper we give an overview of the technical, design, and applications research we are carrying out to make Digital Simplicity a reality.

Tenets of Digital Simplicity

One tenet of Digital Simplicity is to tackle problems that have a high value to the intended customers. We are trying to *simplify* complex, high value but relevant problems. This means not only do we conduct thorough user research with an eye for identifying such problem spaces, but we also challenge the conventional technology solutions. For example, two of the application areas we are working on are eldercare and personal fitness. Both of these are areas of high value to society and the individuals involved.

At the same time, technology that is introduced to solve complex, high value problems should not be overly complex itself. Introducing complex technology will solve one problem by introducing another. Thus, the second tenet of Digital Simplicity is to simplify the user interfaces and technology that we introduce to solve complex, high value problems.

Digital Simplicity strives to simplify previously complex problems with simple to use technology. With no further refinement, this charge includes just about every major problem facing the planet. Digital Simplicity is concerned with a much smaller subset of these complex problems. In particular, the focus of Digital Simplicity is on tackling problems in our home and personal lives rather than problems of the office or other work domains.

These home and personal needs are particularly interesting from a research perspective. For example, they often involve long-lasting physical activities that span several hours or days (e.g., exercising or helping care for a loved one). The information associated with these problems is often poorly structured (e.g., the comings and goings of an entire family). In addition, the measure of success for these problems often has to do with quality of life rather than efficiency or productivity. These characteristics make such problems more challenging than the typical office scenarios that have been the focus of the bulk of computing research. Finally, information technology adoption is limited in our homes and personal lives for applications beyond entertainment and the transformation of office productivity applications to the home environment (e.g., accounting→home finances).

Applications, Design, & Technology for Digital Simplicity

Our current research into Digital Simplicity is broken up into three thrusts: applications, design, and technology.

We are currently focused on two major applications. The first helps individuals care for loved ones who are aging in place. The problem of caring for elders impacts the life of the primary caregiver, commonly a spouse or adult child, for the worse. These caregivers often give up their jobs, forego vacations, and let their own hobbies and fitness lapse while taking care of the elder. This is an urgent, complex problem that has been made even worse by the rising cost of healthcare and the impending imbalance between elders and non-elders in our society [Dishman 2004]. The primary thrust of our work has been to install sensor networks in the homes of elders and to infer the activities they are engaging in [Philipose et. al. 2004]. These activities of daily living (ADLs) are the primary source of information for the CareNet Display [Consolvo, Roessler, & Shelton 2004], which can be used by the elder's care network to easily observe how the elder is doing and coordinate their care-related activities in a low cost way [Consolvo, et. al. 2004].

The second application we are exploring is in the area of Personal Fitness. The idea here is to help people find time in their busy schedules to become more physically fit. Tracking and journaling activity, weight, and nutrition have been shown to be key in

improving fitness [Tsai & Wadden 2005]. Unfortunately, many find this task difficult to accomplish and believe they simply do not have the time to put in the activity required to become and remain fit. Our vision is to give users ways to find time and meet their goals by getting "credit" for things they are already doing and by encouraging them to do more. For example, when the system infers that an individual takes the stairs in their office instead of the elevator [Lester 2005], our system could use a variety of feedback mechanisms to encourage them to make that substitution on a more regular basis. We are studying how best to motivate individuals in this situation without creating complex interfaces that are perceived as pushy [Fogg 2002].

Our design and technology research comes out of exploring these two application areas in detail. Our design research is focused on three key areas: 1) sensors and actuators that can be easily installed and maintained while also being aesthetic, 2) a universal low-level interaction language that allows one to understand the basic operation of ubiquitous computing environments and appliances in different homes, and 3) a design pattern language for communicating successful Digital Simplicity design knowledge to practitioners.

Finally, our technology research is looking at three important ideas: 1) creating the battery-less sensors mentioned above [Philipose et. al. 2005], 2) using activity-based context to support successful natural multimodal input to control applications and activities in the home, and 3) simply configuring home environments by demonstration.

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