Personalization for Tangible Interfaces

Angela Chang
Tangible Media Group
MIT Media Lab
Cambridge, MA 02139
anjchang@media.mit.edu

Hiroshi Ishii
Tangible Media Group
MIT Media Lab
Cambridge, MA 02139
ishii@media.mit.edu

ABSTRACT
We describe a perspective on the evolution of TUIs with regard to *personalization*, by proposing a research theme emerging from trends in industry and academia. We present a framework for this design space and how TUIs populate this space. Elements of personalization and issues surrounding further incorporation of personalization are discussed. We propose research in personalization as a way to increase the commercial viability of TUIs.

Author Keywords
Tangible interfaces, personalization, user customization

INTRODUCTION

The emergence of the multibillion dollar computer peripherals market confirms that personalization is not a fad, but an evolution of how people choose to interact with everyday devices. In the GUI world, wide arrays of tools and products have become available for customizing the software experience, challenging the dominance mediated by large corporate brand identities. However, this trend of personalization has not found similar adaptation in TUIs.

Personalization, as defined from the user's point of view, is the ability to *control parameters* in an interface. From the user's perspective there are two types of control, intentional and unintentional. The HCI design space naturally incorporates physical and digital domains. This paper presents case studies in how TUIs achieve different levels of personalization, and thus become more accessible through strategic discussion of the personalization design space.

BACKGROUND

We draw our inspiration from the field of consumer products and observing some exciting and profitable trends in the marketplace. Companies like Swatch and Nokia pioneered new fashion trends with their interchangeable faceplates for watches and phones (Figure 1). On desktops, changing the graphical look and feel began with custom desktop backgrounds and graphical themes.

Figure 1. Swatch watches demonstrate mechanical personalization, a user can customize the look and feel of the watch by upgrading the straps or the faceplate.

Table 1 depicts a design space for personalization. Users can intentionally control physical aspects of their interface (e.g. colors and custom textures), while wear and tear can manifest due to inherent properties of a physical interaction. In the digital domain, users can customize the graphical appearance of menus and applications (docking menus, icon positions, color schemes), and sometimes, the software will adapt to the user's actions (e.g. context sensitive menus or list of recently used items).

ELEMENTS OF PERSONALIZATION

We believe that the features of personalization can be grouped into two design categories of interface control: 1)*Scale* and 2)*Metamorphosis*. We briefly describe these elements and present how these elements can have both physical and digital manifestations.

Scale, Granularity and Gestalt

Control through different scales is one element of personalization. The ability to manipulate an interface at varying layers of detail gives inherent power to users. Users can utilize the gestalt presentation by seeing an assembled configuration. If this meta-level view is coupled with the ability to zoom down and adjust the specific granular components that make up the whole interface, then the user has a fully customizable interface. The ability to personalize the interface at different levels of detail enables a range of interactions from large dataset operations to tweaking individual variables. By having tools to group and organize information, users can enact changes through many levels of information. By allowing users to focus on microscopic parts of an interface, users can tweak specific behaviors and get the exact control they may desire.

Design Space for Personalization	physical	digital
unintentional	wear and tear over time in response to use shape and texture be more comfortable due to body pressure	context awareness digital history (e.g. Edit wear and Read wear) background software updates
intentional	fashion: choosing custom face plates or brand identities aftermarket economy: expressive/functional augmentations of peripherals	spatial arrangement of desktop icons and toolbars graphical appearance of menus

Table 1. Personalization Design Space

Metamorphosis, Transformation, Fluidity and History

Metamorphosis deals with the transition of an interface over time and space. It is the control of time and multimodal information within the interface. How would our interfaces represent history, memory or evoke nostalgia? If interfaces could take into account the whims of fashion and style, the freedom of multiple modes of expression, and constant environmental changes, then the result is a dynamically evolving interface. There would be elements of consistency, and variations upon those elements. The interface may be constantly changing but cohesive in function.

The following paragraphs articulate the design space more fully and relationships to scale and metamorphosis.

Physical-Unintentional

Human physical contact often wears physical interfaces. An often-cited case is where someone uses a favorite ping-pong paddle, the handle becomes worn and more comfortable over years of use. The shape and texture smooth out the surface due to the friction between the hand and the object. Over time, this object becomes unique, and shows a history of the user's interaction.

Digital-Unintentional

Hill mentioned the traces of history and how it could be digitally represented[75]. The unintentional recording of history has become quite common in software. A large rsearch field called *context awareness* considers how an interface adapts to the user over time. One problem with unintentional digital personalization is in the domain of background software updates. For example, XP users recently found the look and feel of the Internet explorer browser upgraded by Microsoft. The resulting confusion over favorite missing icons and the immediate need to adapt new usages (people had to learn about Tabs) was an unwelcome surprise. [1]

Physical-Intentional

Users inherently customize their physical work spaces to represent information in meaningful ways. Metamorphosis, embodied in self-expression and fashion, are key drivers in this design area. As discussed before, this is a multibillion dollar industry for computer peripherals, automobiles, and fashion ([8]). Companies like Dell developed the idea of shipping user-specified computer configurations, and catapulted to the top of the hardware marketplace ([8]). The control of scale, however, is uncommon in physical-intentional interfaces.

Digital-Intentional

Users have long been able to change font sizes, physical layout, and behaviors of graphical elements.. One notable development is the wide availability of skinning or customization themes. Metamorphosis and scale control are quite common in this design area. For example, the ability to download from a wide assortment of colorful Mozilla internet browser themes[2] is a feature that seems to have roots based on the popularity of personalized web portals (such as provided by Yahoo www.yahoo.com).

EXAMPLES OF PERSONALIZATION IN TUIs

A few examples further articulate how these design spaces have been populated by TUIs. Four example projects demonstrate different levels of support for personalization.

Topobo

Topobo is a construction toy that allows users to explore the dynamics of motion by assembling moving structures [11]. Varying sizes and shapes of creatures can be built (Figure 2). The user can then program the full mechanism by recording the motions that will be repeated by the mechanism. The user can also interchange components to tweak the overall motion. Topobo has some challenging manufacturing issues due to the physical complexity of the elements, but has been successfully manufactured in small batches.

Sensetable

Sensetable is a table that tracks pucks moving across the

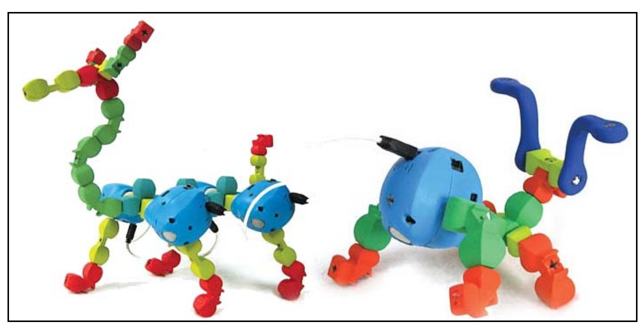

Figure 2. Topobo allows physical metamorphosis.

---

[1]http://www.marketingpilgrim.com/2007/01/sentiment-analysis-for-internet-explorer-comparing-to-firefox.html.

[2] iPox 1.2 theme has over 1 million downloads 1/12/07. https://addons.mozilla.org/

surfaces [9]. Users can alter the spatial location of a few pucks and change parameters associated with those pucks (Figure 3). This project addresses the physical intentional personalization space, where users can easily customize the placement of items over the tracking surface. The hardware has been commercialized by NTT[3] as a high-end business simulation platform.

Amphibian: Physical-Digital Link Scale

The Amphibian project was based on modifying an off-the-shelf postal scale [2]. The software is freely available for download, and the cost of the hardware from RadioShack was originally $20. The project allowed users to create custom TUI links by linking digital commands with items placed on the scale. Inadvertently, Amphibian also supported physical intentional personalization, as users laid out their space according to their priorities (Figure 4). Varying scales of interactions are achieved, as the number of items could be used together or alone. Users also employ the system to tell stories and give multimedia performances.

Reconfigurable Interface Controller

Other projects that support intentional physical and digital personalization explicitly are Phidgets[5] and the VoodooIO controller [13]. Users assemble an interface from atomic units of control such as buttons, knobs and sliders (Figure 4). Like Topobo, this platform allows users to create a composition of these elements and control the interface on different scales (from gestalt to atomic element). By giving freedom to the arrangement of elements, users can create layouts to suit their needs. Users create new interfaces by rearranging these components for gaming.

DISCUSSION

Researchers could think about the ways in which the incorporation of history, shape change, or control of scale could be expanded in current TUIs. Many TUI projects demonstrate spatial layout as a means to intentional physical personalization [1,2,5,6,9,10,11,12,13,14]. Emphasis on material properties could open up new avenues of physical personalization. For example, elastic fabrics can match stretch to scale. Topobo's transforming shapes engage the fluidity of history and motion. Another method may be to record and playback the history of use unintentionally, as in TouchCounters[14], which recorded the item removal history using RFID-tagged shelves. The wealth of ways in which physical forms could map to digital functions is open to the designer's creativity [3].

TUI software sometimes requires users to rely on tech support or programmers for customization (e.g. Ambient orb mappings via www.ambient.com). Perhaps developing new programming tools for integrating information across domains could alleviate this problem [6]. Amphibian solves this with a drag and drop interface. Both [2 and 6] leverage the GUI interface. Another method is to use programming by example, as in Topobo and other construction kits, closing the loop between programming and execute states.

Figure 3. Sensetable allows users to configure the physical location of pucks and the selection of audio snippets intentionally.

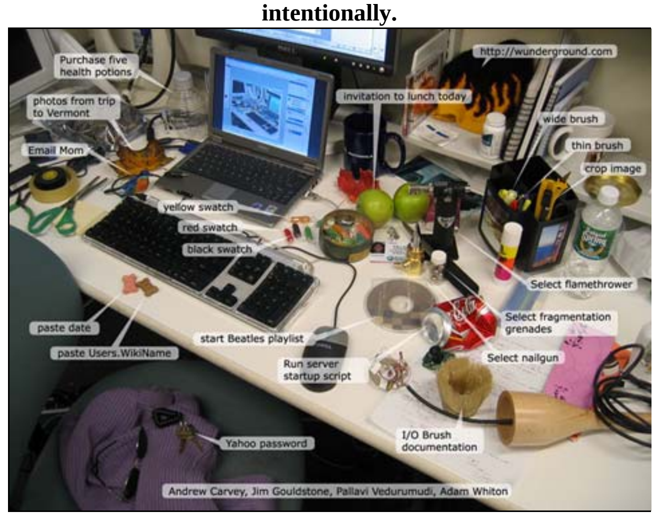

Figure 4.The user can customize their physical-digital links.

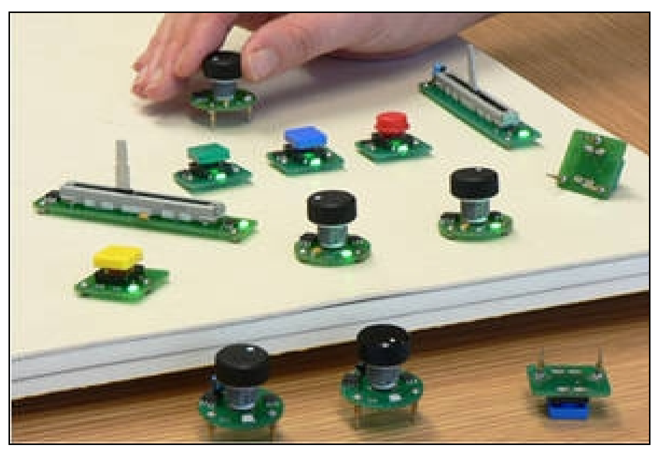

Figure 5. Voodoo IO enhances games by allowing user to customize the layout of physical arrangement.

[3] http://www.media.mit.edu/sponsors/sc-ntt.html

Personalization for Universal Usability

If an interface platform is robust enough to support personalization, then it might also be made quite simple and affordable. Users can acquire a cheap basic configuration and add on only what they need. One contribution of personalization is universal usability. Users who need special interfaces might be able to easily personalize their needs (e.g. larger controls for better dexterity, Braille interfaces).

Simplicity vs. Confusion?

Some researchers argue that personalization could cause confusion for end-users, "What if I try to use your interface and it looks unrecognizable to me?"

Having something that is unique could be an advantage, e.g. touching and feeling something that caters to the user. Although there may be a proliferation of new, unrecognizable interfaces, we predict that there could also be convergence to certain types of arrangements or customizations (e.g. multimedia keyboards or preconfigured PCs). The internet will undoubtedly provide venues where people could pool together and exchange customizations. Users are quite enthusiastic about comparing and trading customizations (e.g. gaming (http://www.makesomethingunreal.com/) and harnessing the power of community co-creation , (e.g. ad filtering software (http://en.wikipedia.org/wiki/Filterset.G).

TUI Evolution

Previously, we mentioned that the ease of customization and distribution were two main personalization issues facing TUIs [4]. We hope that as TUIs increasingly support personalization by solving ease of customization and distribution issues, this will aid in commercialization. We encourage the development of software architectures that will enable users to create, adapt, and share personalization content. Similarly, the development of robust mechanical platforms can bring the cost of TUIs down (as in the case of the Amphibian scale). Perhaps in the future, our interfaces won't become obsolete—they will evolve with us over time and can be passed on through generations, like tangible heirlooms.

CONCLUSION

We have presented our alternate vision of the evolution of TUIs. A framework for future research on TUI personalization is presented. We examined examples that fill this design space, and show implications of this research agenda. We envision that through increasing personalization research, TUIs may evolve to become more accessible, increase usability and increase in personal significance to end-users.

ACKNOWLEDGMENTS

We thank many researchers from the Tangible Media Group and the MIT Media Lab.

REFERENCES

1. Brave, S., Ishii, H., Dahley, A. Tangible interfaces for remote collaboration and communication. *Proc. of Computer Supported Cooperative work (CSCW '98),* ACM Press, New York, NY, 1998, 169-178.
2. Carvey, A., Gouldstone, J., Vedurumudi, P., Whiton, A. and Ishii, H. Rubber Shark as user interface. *Proc. Of CHI2006*, ACMPress (2006). 634-639. http://amphibian.media.mit.edu/
3. Chang. A., Gouldstone, J., Zigelbaum, J. and Ishii, H. Simplicity in Interaction Design. e *Proc. of Tangible Embedded Interfaces 2007 (TEI2007),* ACMPress (2007). 135 – 138.
4. Chang. A., and Ishii, H. Personalized Interactions with Reality-Based Interfaces. *CHI2006 Workshop. http://www.cs.tufts.edu/~jacob/theory/*
5. Greenberg, S., Fitchett, C. Phidgets: easy development of physical interfaces through physical widgets, *Proc. Of UIST 2001: ACM Symposium on User Interface Software and Technology*.ACM Press(2001.), 209-218.
6. Hartmann, B., S. R. Klemmer, et al. Reflective physical prototyping through integrated design, test, and analysis. *Proc. of UIST 2006: ACM Symposium on User Interface Software and Technology*.ACM Press(2006.), 299-308.
7. Hill, W.C., Hollan, J. D., Wroblewski, D., McCandless, T., Edit Wear and Read Wear, CHI 1992, Monterey, CA. ACM Press. 3-9.
8. Kelley, T.Littman, J., and Peters, T. *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*, New York, Doubleday, 2001, 183, 213.
9. Patten, J.A., Ishii, H. A comparison of spatial organization strategies in graphical and tangible user interfaces,*Proc. of DARE 2000*,ACMPress(2000),41-50.
10. Patten. J., Ishii, H., Hines, J. and Pangaro, G., Sensetable: a wireless object tracking platform for tangible user interfaces. *Proc. Of Conf. for Human-Computer Inter.(CHI2001),* ACM Press(2001), 253-260.
11. Raffle, H. Parkes, A. and Ishii, H. Topobo: a constructive assembly system with kinetic memory. *Proc. Of Conference for Human-Computer Interaction (CHI2004),* ACM Press(2004), 647-654.
12. Ullmer, B. and Ishii, H. Emerging Frameworks for Tangible Interfaces, *IBM Systems Journal* 393, 3, 2000, 915-931.
13. Villar, N. Gilleade, K. M., Ramduny-Ellis, D., and Gellersen, H. The VoodooIO gaming kit: a real-time adaptable gaming controller. *Proc. of ACM Intl. Conf. on Advances in Comp. Entertainment Tech. (ACE 2006)* ACM Press (2006).
14. Yarin, P., and Ishii, H., TouchCounters: Designing Interactive Electronic Labels for Physical Containers. *Proceedings of CHI 1999,* ACM Press (1999), 362-269.