Peripheral Interaction: Facilitating Interaction with Secondary Tasks

Doris Hausen
University of Munich, Amalienstraße 17, 80333 Munich, Germany
doris.hausen@ifi.lmu.de

ABSTRACT
Working with digital devices, we often do not focus on one task but switch back and forth between several tasks. Usually some of these tasks are only small secondary tasks. But in contrast to the analog world, where we can carry out such tasks in the periphery of our attention (e.g., drinking a cup of tea while being engaged in a conversation), digital devices normally force us to switch windows, context and thereby the center of our attention independent from the magnitude of the task. To improve multitasking with small tasks (e.g., setting the IM state) I am taking a closer look at peripheral interaction, interaction that can be carried out in the periphery of our attention. Thereby I want to minimize disruption by secondary tasks, to carry out both types of tasks, primary and peripheral, more efficiently. To achieve that goal I developed a preliminary classification and selected several aspects to investigate in more detail.

Author Keywords
Peripheral Interaction, Multitasking, Evaluation

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces: Input Devices and Strategies, Interaction Styles

General Terms
Design, Experimentation, Human Factors

INTRODUCTION
In analog life we are capable to carry out small tasks (e.g. walking, tying shoe laces), while being focused on a completely different task (e.g. reading a book, watching TV). In general, multitasking causes interruptions. This cannot be completely avoided, particularly when switching back and forth between important tasks. But – especially with digital devices – marginal tasks (e.g. checking the calendar) ask for too much attention and force unnecessary window and therefore focus switches. As solution I propose peripheral interaction, which I consider as a sub form of multitasking. Tasks are not equal in this case. (At least) one task – the peripheral task – is always marginal, but asks for occasional active interaction in contrast to only monitoring tasks, which are addressed by ambient interfaces [7]. Peripheral interaction adopts the idea of *information* in the periphery of the user's attention from ambient information systems and transfers it to *interaction* in the periphery of the user's attention. Periphery is relative to the user's attention in visual, auditory or haptic form.

RELATED WORK
Edge [1] was the first to coin the term peripheral interaction. However my definition of peripheral interaction is most in line with Olivera et al., who state "Peripheral Interaction is brief because our interaction focus is somewhere else and, [...] we want to deal with it without strongly affecting the main one" [6].

The idea of peripheral interaction is nurtured by ambient information systems, which show information in the periphery but usually only offer passive, non-interactive systems [7]. Concerning evaluation, ambient information demands long-term in-situ evaluations [3], for the additional information to blend into the surrounding. Furthermore research on multitasking offers valuable input on attending at least two tasks at once [4]. Multitasking usually relies on dual task studies and measurement of cognitive load (e.g. Signal Detection Theory) [5].

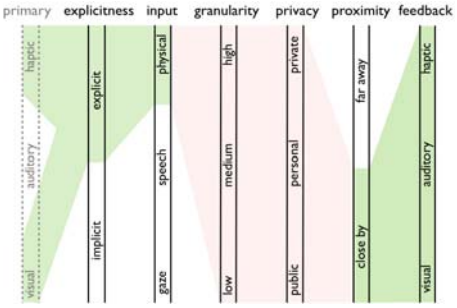

Figure 1. Primary (dashed) shows the senses engaged by the primary task. Other vertical bars (solid) depict design dimensions of peripheral interaction. Areas I am looking at in more detail are highlighted green. Other dimensions (red) will be included in prototypes, but I will not focus my work on them.

RESEARCH GOALS
I am addressing two research goals within my dissertation:

Design Dimensions for Peripheral Interaction
Peripheral interaction up to now mainly focuses on tangibles [1]. I consider other interaction styles possible as well.

TEI 2012, Kingston, Ontario, Canada, February 19 – 22, 2012.
ISBN 978-1-4503-1174-8/12/0002 $10.00

Therefore my first research question deals with the (1) *Design Dimensions for Peripheral Interaction.* To answer the first research question I developed a classification for peripheral interaction [2]. While getting a better understanding of the topic I extended the classification to the version depicted in figure 1.

Feedback for Manual Peripheral Interaction

For my work I selected as primary task an average desk equipped with a computer, display (visual), keyboard and mouse (both haptic). I neglect the auditory channel, because it is hardly used in office scenarios. As peripheral task I decided on explicit interaction carried out by the hands and arms (as subset of physical input). Naturally interaction with the hands is carried out in the close vicinity of the user. Granularity and privacy are going to be included in every prototype per definition, but I will not look deeper into it. Finally, I consider feedback as one of the most crucial and influencing aspects. Consequently my second research question is dealing with (2) *Feedback for Manual Peripheral Interaction*. Manual (i.e. by hand) input includes gestures (touch and freehand gestures) as well as tangibles. Feedback might be visual, auditory or haptic and is dependent on the primary task as well as the secondary.

FIRST PROTOTYPES

To approach the second research question I am building prototypes incorporating manual input and feedback and evaluate them in a two-fold approach: I consider dual task studies in the lab by measuring cognitive load. Additionally long-term in-situ evaluations are necessary, since in a lab study it is hard to get completely used to an interaction, which is supposed to blend into the periphery (cf. [3]).

Figure 2. Left: The *Ambient Appointment Projection* projects calendar data onto the table. By a wiping gesture the user can acquire more details. Right: The *StaTube* shows the user's and contacts' IM states. By turning the upmost level the own state can be changed.

The *Ambient Appointment Projection* (figure 2 left) projects calendar data onto the user's desk. With a casual wiping gesture towards the user, additional information about upcoming appointments (as balloon pop-up on the display) can be acquired. A pulsating reminder animation can be silenced by the opposed wiping gesture. The *StaTube* (figure 2 right) depicts the user's IM state (upmost level), and selected contacts' states. By turning the upmost level the state can be changed.

The *Ambient Appointment Projection* has been evaluated in a lab study (typing task as primary task). Further, both prototypes have been evaluated in an in-situ deployment, which revealed the necessity of getting used to the interaction to move to the periphery. Nevertheless, especially the *StaTube* showed that state updates were carried out more frequently using the prototype than the regular GUI.

Table 1. Prototypes sorted into the matrix of manual input and feedback.

		Feedback		
		Visual	Auditory	Haptic
Manual Input	Tangible	StaTube	Audio Player	StaTube
	Touch		Audio Player	
	Freehand	Appointment Projection	Audio Player	

CONCLUSION & FUTURE WORK

As future work I plan on filling the matrix depicted in table 1. Currently I am working on a comparative prototype (tangible vs. touch vs. freehand gesture vs. media keys) for auditory feedback, which controls an audio player.

ACKNOWLEDGMENTS

I thank my supervisor Andreas Butz and my colleagues, Dominikus Baur, Sebastian Boring and Max-Emanuel Maurer, for their valuable feedback. Additionally I want to thank Simone Rodestock and Julia Polleti who co-developed the protoypes.

REFERENCES

1. Edge, D. Tangible User Interfaces for Peripheral Interaction. *Technical Report*, Univ. of Cambridge (2008).
2. Hausen, D. and Butz, A. Extending Interaction to the Periphery. *Embodied Interaction: Theory and Practice in HCI, in conjunction with CHI,* (2011).
3. Hazlewood, W.R., Stolterman, E., and Connelly, K. Issues in Evaluating Ambient Displays in the Wild : Two Case Studies. *CHI*, (2011), 877-886.
4. Jamson, A., and Klöckner, K. User Multitasking with Mobile Multimodal Systems. In: Minker, W., Bühler, D., and Dybkjær, L. (Eds.) Spoken Multimodal Human-Computer Dialogue in Mobile Environments. (2004)
5. Leung, R., MacLean, K., Bertelsen, M.B., and Saubhasik, M. Evaluation of Haptically Augmented Touchscreen GUI Elements under Cognitive Load. *ICMI*, (2007), 374-381.
6. Olivera, F., García-Herranz, M., Haya, P.A., and Llinás, P. Do Not Disturb: Physical Interfaces for Parallel Peripheral Interactions. *INTERACT*, (2011), 479–486.
7. Pousman, Z. and Stasko, J. A Taxonomy of Ambient Information Systems : Four Patterns of Design. *AVI*, (2006), 67-74.