A Model of Calm HCI

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Abstract

We propose a model of human-computer interaction (HCI) that incorporates the Peripheral Interaction (PI) that is a requisite part of what Weiser and Brown called the most important aspect of Ubiquitous Computing: "Calm". Standing firmly on the shoulders of earlier models of interaction, the Brown-Hitz model provides a simplified, three-tiered input/output system illustrating reflexive, pre-attentive, and attentive components of natural human interaction. An example is provided to show how the model offers an improvement over earlier models.

Author Keywords

Peripheral Interaction, Calm Technology, Anthropology-Based Computing

ACM Classification Keywords

H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction

Calm Technology should allow users to assess new information peripherally, enabling them to decide whether to divert their attention and change their focus [2]. It is well understood that humans can process information in several different ways, using different parts of the brain and nervous system, depending on how it is presented to
them. Despite that understanding, models of HCI have focussed on deliberate, attentive interaction. To date there have been no models of HCI that could account or even allow for peripheral interaction. We believe such a model is the next logical step.

Other Models of Interaction
Norman proposed a 4-step model of the Human Action Cycle. "Thus the full cycle of stages for a given interaction involves: executing the action; and evaluating the outcome." [8]. Many authors have tried to improve the model of HCI, by providing additional details.

Abowd and Beale [1] provide a model that shows the incoming and outgoing actions on both the "human" and "machine" sides of an "interface" that is labeled with both "input" and "output" (redrawn in Figure 1). The four translations become the focus of this model in order to enable formal analysis of interface-based issues.

Mackenzie [6] simplifies the model, giving the reader three items on each side of the dotted line that represents the interface. The two directional items on either side of the line are now labeled in terms of computer use. The human’s “motor responses” now exert actions on the computers “controls”, and the computers “displays” feed into the human’s “sensory stimuli”. This is redrawn (with the components flipped horizontally in order to maintain a consistent direction across figures) in Figure 2.

At APCHI, in 1998, Coomans and Achten introduced a more complex model, one that illustrates the processes between each action, labeling them with such descriptive terms as "thinking", "representing", "rendering", and "abstraction" (redrawn in Figure 3) [5]. This model gives some implicit value to the differences between human and
computer, telling us that computers use “processing” on “knowledge in internal digital representation”, while humans conduct “rational thinking” using “knowledge” in an “internal mental representation”. The other matters of note are the way in which input devices are used to “abstract” human intent from a physical representation into something that can be interpreted by the machine, while the output device renders the machine’s “output representation” into a “physical representation” that can be perceived by the human’s “senses”.

This is a more human-centered model, with separate arrows for different kinds of “physical representations” that have been rendered and presented to the human, and separate arrows for the different kind of senses that might perceive these signals. It does the same for the human effectors, suggesting that there may be multiple separate channels of human output that could be driving computer input devices. Now that a model has proposed that humans and machines process information differently, and that humans deal with multiple, simultaneous streams of input and output, we will formalize the idea by illustrating the levels of attentiveness at which this happens.

We propose the Brown-Hitz model (Fig. 4) to illustrate the means by which multitasking and peripheral interaction take place, thus pointing towards the HCI modifications necessary to enable Calm Technology (CT). Based on the theory of “Anthropology-Based Computing” (ABC) [3], our model separates “attentive” interaction from the “pre-attentive” and “reflexive” information sensing and processing that take place elsewhere in the brain. This illustrates a natural aspect of human interaction with the world and suggests the possibility of deliberately-parallel input and output devices that would focus on one or the other of these sensing and processing modalities.

**Pop-Up or Fade-Up: An Illustrative Example**

You are writing a paper and an email arrives in your inbox. The pop-up appears suddenly. As a result of a misunderstanding of the term periphery [4], it is likely
that the pop-up has attracted your visual attention. Whether you try to close it or simply wait until it fades, you have already begun processing the text. Not only is the message not available for peripheral interaction, you are now thinking about it whether you wanted to or not.

Now imagine a signal designed to trigger only the pre-attentive portion of your sensory system so that you perceive subtle signals and recognise familiar patterns without interrupting attentive focus. Our "fade-up" has no text, just the image from the sender’s profile. It appears quietly, fading up from fully transparent to partially so and then fading out again right away. Unlike other systems, it never intrudes beyond the periphery [7]. Glancing at it is like glancing at a face passing by: you either recognise it or you don’t. You decide whether or not to pursue more information, based on your own preferences at the time. Waiting for an important email from that sender? Click on the pop-up. Want to continue what you’re doing without interruption? The pop-up is already gone and never interfered with your work. What’s more, you have pre-attentively either recognised the image or recognised that some unknown icon has appeared. In either case, you have been informed - on the periphery - and you can go looking for more information if and when you choose to do so.

Conclusions and Future Work
We are testing fade-ups and calm ringtones, but it is our hope that our model will have implications beyond HCI. It could be of great benefit in the field of Human Factors, with particularly important application to control systems in transportation and hazardous industries where human error is associated not only with stress but with incidents, accidents, and disastrous outcomes.

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