Towards Transparency in Pervasive Information Display: Possibilities for Attentionally Managed Tactile Signals

SENSORY PERCEPTION AND INTERACTION RESEARCH GROUP

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Motivation

Too much information can be **overwhelming**, and needs to be presented with respect for a user's overall attentional load.

We propose that **user attention can be conserved** by **managing sensory modality and salience** of incoming information.

To this end, our research program is exploring how to **deliver information haptically with minimal attentional load.**

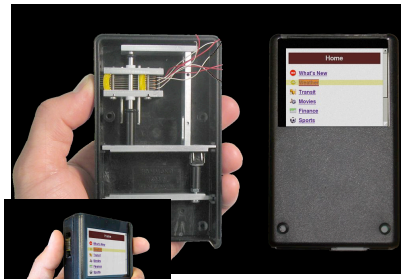
Some Opportunities

Mobile environments

Time-and-safety critical

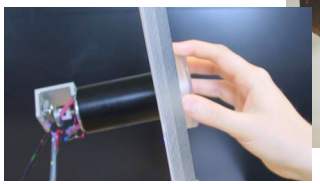
Everyday manual controls
Who's at home?

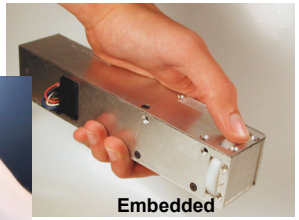
Some Delivery Platforms



Piezo handheld skin-stretch display (w/ V. Hayward, McGill)

Vibrotactile displays





Embedded force feedback knobs

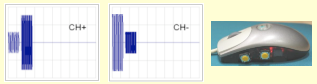
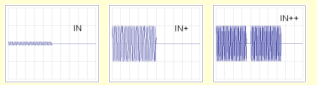
One Mechanism: Haptic Icons

Haptic icons are brief tangible stimuli with associated meanings, composed by varying the control parameters of given haptic display.

***Transparent* haptic icons** convey information without grabbing your attention, unless it's needed.

events • function identity • content identity • media browsing

Example of icons used in a protocol to mediate turn-taking in distributed collaboration (Chan et al 05, 08)

Change in Control	two-tone buzzes (1x)	
In Control	heartbeat (1 / 2.0s)	
Waiting for Control	quick tapping (1 / 1.0s)	

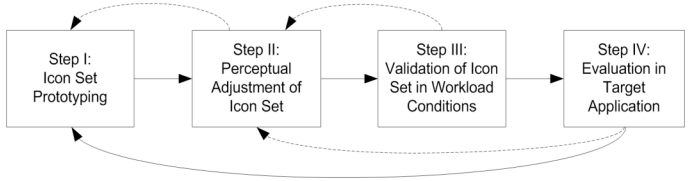
2-sec segments

Designing Transparent Haptic Icons

Sets of haptic icons must:

- be **distinguishable**
- make **efficient use of limited expressiveness** of today's displays
- have **salience** appropriate **within the set** and **for the context**
- be **learnable** in a reasonable time / manner

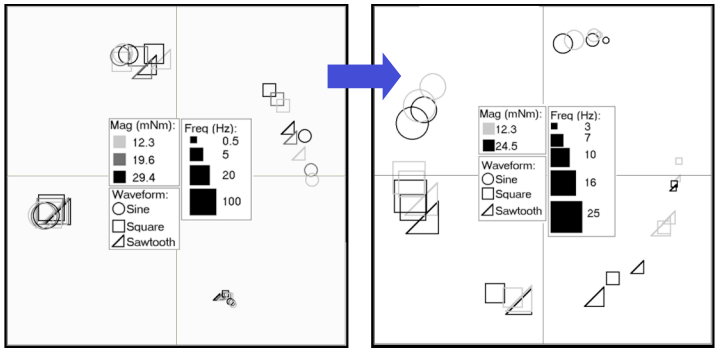
A proposed iterative **design process** (Chan '08) incorporates perceptual adjustment and "stress testing" to predict behavior in real environment:



Perceptual Optimization of Icon Sets

In Perceptual MultiDimensional Scaling (**MDS**), stimulus dissimilarity data allows **efficient visualization** of how users **mentally organize** the stimuli, and helps create icon sets that are **distinguishable** and **cognitively easier to learn**.

Iterative rapid prototyping: These two maps plot **perceived relative location** of 30-36 stimuli. Each required **only ~5 hours of user data**. The right one was produced by **adjusting stimulus design parameters** after reviewing the left one.



How Many Haptic Icons Can We Learn?

Current work is investigating acquisition over time of **up to 84**, and we believe the answer is **hardware- not human-limited**.