EXPRESSIONS
TOWARDS A DESIGN PRACTICE OF SLOW TECHNOLOGY

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Abstract

As computer use increasingly influence everyday life, we need to complement our knowledge of the computer as a technology for creating fast and efficient tools, with other perspectives on information technology. We describe *Slow Technology*, technology aimed at promoting moments of reflection and mental rest. Taking the design programme of Slow Technology as our starting point, we have explored expressions of the acts of reading and writing information using computers in everyday life. A number of design examples including the Fan House, the Chest of Drawers, the Lamp Foot and the Fabric Door, have been created. The purpose with these examples has not been to create new information displays, interaction devices, artworks or products, but to create a basic collection of examples that

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can support systematic investigation of the aesthetics of computational technology as material for the design of everyday things. Experiences from the design and exhibition of these examples are presented as design leitmotifs for future work with Slow Technology.

Keywords: Experimental design, computer aesthetics, design theory, design research, Slow Technology

1 Introduction

The general agenda of HCI research is to study, describe and design the interaction between people and computational artefacts. In practice, this is often done in a limited domain of computational tools specifically created to aid people in performing a certain set of, primarily work-related, tasks. The knowledge gained from using computers to create efficient tools at the workplace can be applicable in other domains, but there are aspects of interaction design falling outside a strict focus on functionality and usability that still are very important in the design of everyday things.

Consider, for instance, the design of a doorknob. The basic functionality of a doorknob can be expressed through clear affordances that support the use of the doorknob as a fast and efficient tool for opening the door. However, the act of opening the door also has a certain expression that we may reflect upon when we open the door and enter a room. This expression is not captured by a reference to pure functionality; it concerns the aesthetics of a doorknob in use. During the design process, we must at some point, explicitly or implicitly, consider this question – the aesthetics of things in use is inherent in the foundation of modern design. As computers increasingly pervade our everyday lives, the aesthetics of things in use will gain importance in human-computer interaction design as well.

The basic working hypothesis adopted here, is that we have to investigate the properties of computational technology as material for design to gain an understanding of how it can build the appearance of everyday computational things. This kind of research is often carried out in terms of experimental design work: speculative design, critical design, meta design etc. Examples related to HCI research include "Alternatives" [2], where a number of conceptual design proposals for information appliances were presented, critical design of electronic products by Dunne [1] and the Xerox PARC Artist-in-Residence program [4].

In this paper, we describe experimental design exploring the ever-present *expressions* of basic acts of information technology use: the reading and writing of information. We focus on the expressions of these acts almost to the point of completely neglecting their associated functionality. What we hope to gain is a better understanding of the *aesthetical* aspects of computational technology as material in the design of everyday things.

2 Slow Technology

When artists, designers, architects and engineers build an understanding of the properties of a material, they often study it by creating a structured collection of basic examples that explore different aspects and properties of the material. A basic understanding of the properties of, e.g., wood, paint, concrete, as materials for design, can perhaps only be achieved by working with them in practice. More systematic studies of the material are then used to map out the design space of possible expressions.

This notion of a structured investigation of a design material is the basic method of the work presented here. The purpose has not been to create applications, appliances or artworks, but to create a collection of

examples that can support our understanding of aesthetical properties of computational technology as material for design. We have carried out our experiments by creating examples on basis of a design programme based on initial conjectures about the material. The experiences gained from this experimental work are then presented in terms of design guidelines, or design *leitmotifs*. In the work presented here, *Slow Technology* is the design programme; the acts of *reading and writing* using information technology is the part of the design space we are investigating; the *displays and devices*, including the *use scenarios*, constitute the examples; and finally the *design leitmotifs* present the experiences gained.

2.1 Framework

The basic premise of this work is that computational technology (computers) can be seen as design material, much in the same way as any other material we use to build everyday artefacts. Just like any other material, the computational material has specific properties that enable us to form certain expressions and to achieve certain functionality.

We have taken the exploration of temporal structures and different time-spans as a starting point for an investigation of the aesthetics of computational material. Basically, computers display the execution of programs, i.e., temporal structures. Thus, the expressions of computers have much to do with the expressions of temporal structures and correspondingly interaction design is concerned with how such temporal structures are expressed in human-computer interaction acts. In our experiments, we use the slow appearance of things to expose and amplify properties of temporal structures.

Slow Technology [3] is a "magnifying lens" through which we try to study the expressions of everyday computational things. Especially, we aim to work with time as an explicit design variable. Aesthetics, not

functionality, is in focus. When we reflect on the expressions of computational things in use, they disappear as tools and their presence as temporal structures becomes amplified. The time perspective can then be changed and opened up for a technology that is slow in the sense that it is designed for reflective use. Slow Technology is technology that is slow in appearance, learning and understanding.

2.2 Focus on Expression

What does it mean to focus on the expressions of an artefact in use almost to the point of neglecting its functionality? Imagine using a pen but once you begin to write, you stop and reflect on how its shape affect the way you hold it and how you will form the letters. Then you think of where on the paper you will begin to write, how the ink will look when put on the paper, and so on. Here, the writing of a specific text is irrelevant. Still, it is clear that it is the expressions of a pen in use and nothing else that we reflect upon. To slow things down and reflect on the expression of an activity is also essential in traditions such as the Japanese Tea Ceremony.

3 The Expressions of Reading and Writing Information

The basic acts of using information technology can be characterised as reading and writing information: we write information as we type commands on the keyboards or draw figures with the mouse; we read information represented as, e.g., graphs and text on the screen.

A growing body of work has shown that there are many possibilities to broaden the spectrum of design strategies for human-computer interaction. Weisers visions of ubiquitous computing and calm technology (cf. [7]) were to some extent based on questioning the

suitability of present forms of interaction. Within tangible media, several alternatives to present forms of information input and output based on the use of physical representations for digital information has been presented (cf. [6]). Both ubiquitous computing and tangible media have shown that human-computer interfaces can be created as a (natural) part of our everyday environments and that this integration might be an important step to putting the technology in the background rather than in the constant foreground of our attention.

Now, if our interest lies in finding out more about the properties of computers as material for the design of everyday things and environments, how can we build on these lines of work? One way is to keep questioning the basis for interaction design –how to support different forms of reading and writing information– but to do it from a different perspective that focus on the expressions of these acts and not on their associated functionality (cf. [1]). We have concentrated on the acts of reading and writing information in everyday life through everyday activities. We can, for instance, think about how we use thermostats to control heating, on/off switches for lamps to control lighting, or how we use doorbells to call for attention. These activities are very different from reading and writing texts using information technology, but they *are* elementary examples of situations where we interact with technology by reading and writing information.

To explore this, we created a number of devices to be used as a part of an everyday environment. The purpose was not to invent "new" technology, but to work with elementary modes of expression. We have aimed at exposing the aesthetics of computational material by amplifying and transcending acts of "reading" and "writing" information, such as: reading from public displays; communicating through devices, e.g., pressing doorbells; opening and closing closet doors, pulling out and pushing in drawers; entering and leaving a room, e.g., peering into, looking out, kicking the door open, slamming the door.

4 Displays and Devices

The displays and devices presented are designed to be slow in several different ways. Many of them are slow in the sense that they can not display rapidly changing information, but they are also slow in the sense that it takes time to use and understand them. They require people to reflect in order to make sense or to be "informative". There is no reliable precision in measuring distance, light, movement, or in the calibration of scales in any of these "tools". They are slow "instruments" for writing and reading information, instruments that require "artistic skill" to achieve precision. They invite to reflection on what, for instance, simple things like moving a metal cylinder between wooden blocks, pulling out drawers, reading patterns in pieces of fabric blowing in the wind, might mean in terms of reading and writing information. The individual displays and devices are described in their respective figure legends.

These displays and devices can be said to be practical examples of different interpretations of what various everyday acts might mean as acts of reading and writing information using information technology. If we think of the Fan House as a general-purpose display and compare it to the ordinary computer display, what happens with the act of reading information as we present information as movements on a surface instead of by changing the colours of pixels in a fixed matrix? Just like the Fan House with the substitution of pixels for moving layers of fabric, many of these examples bear on a relationship with existing interface components: the Chest of Drawers is related to the GUI desktop metaphor with its filing cabinet and folders; the Block Bench with GUI components such as the scrollbar and sliders; the Paper Recycler to information manipulation functionality such as the ability to cut and paste in a word processor; etc. At the same time, they have a strong resemblance to everyday objects made out of materials such as textile, wood, paper, etc. that are traditionally used in interior design.

Figure 1: Fan House
The Fan House is a 3x3-matrix wooden rack with a fan mounted in each cell, and layers of thin fabric are hanging in front. Each fan is individually controlled using pulse width modulation (PWM) from a microcontroller, which in turn is controlled from a PC. Combinations of different layers of fabric of various textures and colours, give a wide range of possible patterns of fabric in motion with fine structured variations.
Reading: as patterns of fabric in motion.
Writing: as patterns of information controlling nine fans.

Figure 2: Fabric Door
Fragments of fabric in different colours and textures are hanging in the ceiling, enclothing the entrance to a room. Each fragment is connected to an accelerometer which measures fabric movements as people pass through the door. A microcontroller registers how acceleration, velocity and tilt angle change over time, and forwards this information to a PC.
Reading: as a pattern of fabric in motion and indirectly as a pattern of accelerometer information.
Writing: walking through the fabric (cf. Japanese textile noren.)

Figure 3: Lamp Foot
The Lamp Foot is a floorlamp with the lampshade placed just above the floor. Inside, there are four small fans directed towards the downside perimeter of the lampshade, perpendicular to each other. Around and below the lampshade, there are dry autumn leaves laid out on the floor. Wind from the fans will transport the leaves out on the floor in different patterns. Each fan is individually controlled from a PC via a microcontroller.
Reading: as patterns of autumn leaves on the floor.
Writing: as patterns of information controlling the fans.

Figure 4: Paper Recycler
A matrix of electronic fans are mounted on a rack, covering the bottom of a cardboard box. Filled with paper fragments, the box and the fans create a display based on the movements of a large number of small pieces of paper in different colours, sizes, shapes and mass. As in the examples above, each fan is individually controlled from a PC. As the speed of the fans is modulated, different patterns of whirling paper can be seen in the wastebasket.
Reading: as patterns of different pieces of paper in motion.
Writing: as patterns controlling the fans.

Figure 5: Sail House
In each cell of a 3x3 matrix wooden rack we have placed paper sails on three wooden sticks, one for each column. Each mast may be used to turn the sails in a column in different directions; each sail can also be manipulated separately. A microcontroller is used to measure the resistance of nine light dependent resistors mounted behind each sail. The amount of light that each sail lets through is continuously measured and forwarded to a PC.
Reading: as patterns of papers sails set in different directions and indirectly as patterns of light intensities.
Writing: setting up different patterns of paper sails.

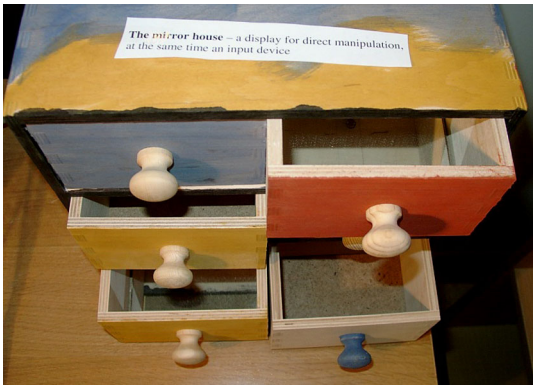

Figure 6: Chest of Drawers
A small wooden chest with six drawers has a mirror attached to the bottom of each drawer. The mirrors reflect light inside the drawer when opened. In the ceiling of each drawer there is a light dependent resistor for measuring the intensity of the reflected light. A microcontroller is used to measure the varying resistances, and the measurements are forwarded to a PC.
Reading: as a pattern of drawers pulled out to varying extents and indirectly as a pattern of light intensities.
Writing: pulling out and pushing in drawers.

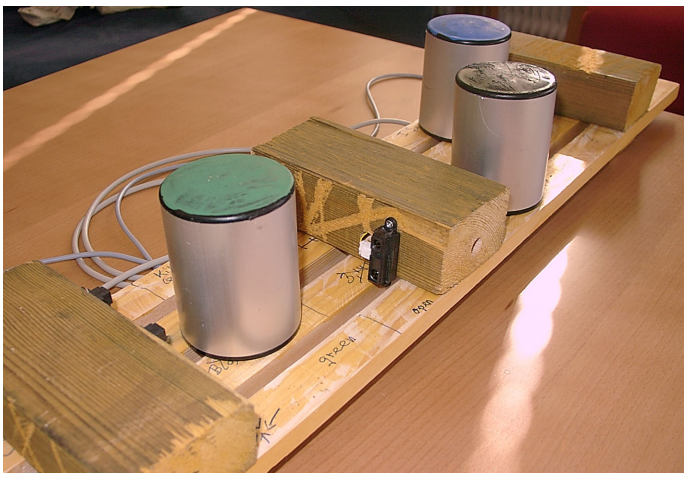

Figure 7: Block Bench
A small wooden bench with three tracks. There are four movable wooden blocks, with proximity sensors facing the tracks. Four metal cylinders are placed between the blocks as sliders. The Block Bench can represent four positions in three different scales. A microcontroller continuously reads the distances and forwards these measures to a PC.
Reading: directly as a pattern of blocks and sliders on the bench and indirectly as a pattern of distance information.
Writing: setting up different patterns of blocks and sliders on the bench.

Figure 8: Tray
A rectangular metal tray is hanging from the ceiling in four wires. Four stepper motors with gears are used to heighten or lower each wire in very fine steps so that the height and inclination of the tray can be precisely adjusted. Objects like marbles, nuts or even coffee cups that are placed on the tray creates patterns when sliding on the tray as the inclination is changed.
Reading: as pattern of moving things on the tray.
Writing: as patterns of information controlling four electrical stepper motors.

5 Use Scenarios

5.1 Simple Display Settings

The display settings described below concern the reading of information. Being parts of a designed interior, the displays will become familiar things over time. As we gradually learn to master the art of reading from these various displays, we will note information in the same manner as we note dust in the corner, or that someone has moved a particular flowerpot to the left in our living room.

History

The four fans of the Lamp Foot (fig. 3) can be made to represent four different sources of information or four aspects of some source of information. The pattern of light material, like dry autumn leaves that are spread out on the floor, will print the history of this information over a period of time.

Reports

Let the three columns of fabric in the Fan House (fig. 1) represent the weather at home, at some distant place, and the weather of the same time yesterday at home, respectively. Let the three rows represent temperature, wind and rainfall. Fabric of different colours and texture can be used to indicate the different kinds of information. In this configuration, the Fan House can be used to continuously deliver a weather report. Another possibility is to combine different kinds of information to create an overview display of, e.g., the energy consumption of a household.

Balance

The Tray (fig. 8) can be configured to display the balance between different processes. For example, we can make each of the four motors represent some source of information, e.g., the volume on stereos, television sets, or temperature measured indoors/outdoors, at home and at the office. The Tray will then show information about the balance between these different sources of information. If there is great imbalance between the different processes, an alarm will occur, as the objects on the tray will fall to the floor.

We can also use the Tray to create a display for the stressed out modern mother/father, who tries to achieve balance in life. For instance, we can let the four sources of information be the amount of time scheduled in the (electronic) time manager for work, for exercise, for spending time with the family, and with mother-in-law, respectively. In case the information sources are not hidden, the display can also be used to encourage other people to reflect upon someone's life situation.

5.2 Simple Communication Settings

Furniture in Use

You can display a part of your daily life by connecting the Chest of Drawers (fig. 6) to the Lamp Foot, thus writing the story of a piece of furniture in use in the form of patterns of e.g., autumn leaves on the floor.

To Enter a Room

The Fabric Door (fig. 2) can be used to display the manner in which people enter a room by means of patterns of moving fabric. The sensors in the Fabric Door will at the same time generate information that can be displayed in ways that mirror and communicate these patterns of moving fabric. For instance, one could set up the Fabric Door with displays like the Paper Recycler (fig. 4) and the Lamp Foot. In the first case one would see the movements of people scaled down to movements of paper in the Paper Recycler. In the second case one would see a history of people moving about in a room as a pattern of dry autumn leaves on the floor in another room.

To Use a Doorbell

We can replace the ordinary doorbell with a silent and subtle way of communicating by placing the Sail House (fig. 5) at the front door and connect it to the Fan House placed somewhere inside. When someone is at the door, he/she can present him-/herself by setting up a certain pattern in the Sail House. This doorbell needs explicit attention to when the fabric of the Fan House begins to move, as well as to how the fabric moves. A quick glance is enough to see that someone is at the door and a more careful inspection will reveal who it is.

5.3 Complex Settings

Connecting several of the displays in various ways open up for more complex settings. The Block Bench can be used to illustrate this. We may think of the Block Bench as giving us a collection of sliders for fine-tuning, browsing and mixing information. Due to the peculiar design of the Block Bench, the expressions of listening, watching and reflecting –activities that are involved in all manual fine-tuning, browsing and mixing– will be amplified as using the Block Bench is an

art that takes a long time to master. This means that these complex settings will ask for even more reflective use than the simple settings given above.

Fine Tuning

We connect the sensors of the Fabric Door to the fans of the Fan House. Three sliders will be used to control sensitivity, mapping patterns between sensors and fans, and the browsing between different subsets of sensors. Now it is possible to use the Block Bench for fine-tuning the display of information from the Fabric Door through the Fan House. It is no meaning to look for exacts measures to remember for a later occasion, we have to "see" that it is "right". In this setting we mix a specific expression of fine-tuning with expressions of reading information in the dynamics of moving fabric.

Browsing

We connect several sources of information, e.g., different sources of information from a weather station etc., to the Paper Recycler or the Fan House. The sliders can now be used to browse through information with respect to differently calibrated scales on the Block Bench. Since a precise handling of the sliders is a rather subtle matter, we introduce a notion of uncertainty. We have to check over and over again to learn what information we are viewing at a given moment. Successively we try to learn to read the patterns of the sliders, but expressions of uncertainty and learning will always be present. Here we mix the expressions of uncertain browsing with expressions of reading information in dynamic material like paper or fabric.

Mixing

We connect the Tray to four different sources of information –e.g., the Sail House, the Fabric Door, a weather station and the Chest of Drawers– where sliders on the Block Bench will represent sensitivity in connection with respect to each source. The sliders can then be used to mix information from these sources, and the Tray will display balance between them. The expression of mixing here will be that of intense listening, trying to understand the meaning of a mixture of information we are in the process of learning to read. Therefore, there will be a combination of the expression of curious listening with expressions of reading balance in the movements of items on a tray.

5.4 Extreme Settings

If we push the notion of ubiquitous computing [7] and the invisibility of computers (also in a phenomenological sense) to the extreme, we can imagine the following: As information is everywhere, we just have to define a display in order to read it. This idea implies that wherever there is expression, there is possible information.

Anything can be made into a display, since a display is just a place where we "read" information. We can, for instance fully integrate the displays and devices described here with the rest of the interior, e.g.: the Fan House becomes the place where you hang your towels, alternatively we place the fans behind the curtains of our living room; the Fabric Door becomes integrated with the wardrobe, clothes replacing the pieces of fabric sensing movements; the Chest of Drawers in the bedroom receives new expressions in use with light sensors, effectively becoming a device for "direct-manipulation" of information; the fans at the foot of a lamp controls the way dust will distribute on the floor in the hallway; the waste basket becomes a display, etc.

Everything we do can then be considered writing: we "write" information as we move around, touch things, speak, etc. Our environment will in return display different interpretations of this information, and everywhere we will be able to "read" information about various things such as what we and others have "written" through our actions. There will certainly be room and incitements for reflection upon these acts of reading and writing information using information technology, e.g.: the curtains moves as someone stands at the door; the TV changes colour depending on the weather outside – or was it the weather of yesterday?; the water tap in the kitchen does not work – did I forget to lock the car?; the dust on the floor is all in one corner – my fiancé is wearing a red dress today, or does it mean that I should pay the rent (I can never remember which corner is which)?

Here, everything is connected to everything else. Wherever there is expression, this expression is amplified as acts of reading and writing of information using technology. Will it matter what is connected to what, and what is not connected at all? The complex patterns of interactions between input and output, between what is an act of writing, where the information comes from, what controls the modulations of the information we are reading, etc., will hardly be possible to discover. The computer becomes invisible to the point that it no longer matters if it is actually there or not. Two interesting insights can be gained from this scenario. The first one is that we probably do not want the computer to be invisible, we just want it to lose its peculiar status as a design material that prevents it from becoming just another material we use for the design of everyday things. The second is that we do not want an information display to be too ambient, too integrated, but instead exposed in a way that makes its expression as an information display clear.

6 Design Leitmotifs

The work presented here is explorative and the ambition has been to uncover new design opportunities rather than to refine already, within interaction design, known ones. Thus, it is not plausible to give any detailed guidelines beyond the point of suggesting an outline for future work and along what lines a design practice might evolve. The guidelines, or *leitmotifs*, presented below represent the more general experiences we have gained while working with the design examples presented in this paper as well as projects preceding these [3, 5]. The experiences have been gained from both working with the design and implementation of the examples, as well as from occasions when people have tried them in real-world settings such as in office environments and at an art museum exhibition.

1. Composing in Time

Computational things are based on the execution of programs. One implication of this is that when working with such things, we work with temporal rather than spatial form. The aesthetics of computational material is clearly related to expressions as "time gestalt". If we want to uncover the intrinsic properties of computational material we have to put dynamics and behaviour over time in focus.

2. The Computer as a Display:

We can think of a computational thing as a display: as something displaying the execution of programs. Using this metaphor, we can also give a non-technical unified account of what a computational artefact is from a users point of view. According to this metaphor, the expressiveness of computational material is "contained" in the expressiveness of a display.

3. The Ubiquity of Information:

When we interpret everyday activities as acts of reading and writing information we can discover that there are potential "information displays" everywhere there is information. If we think about the way a person enters a room in terms of making an "imprint" that is there for others to "read" we uncover a design opportunity also for interaction design: just as the information is there for others to read, it can be used in an act of interacting with a computer. Correspondingly, digital information can be made available in the environment just as the imprint is available.

What is relevant here, is not that we can connect everything with everything else, but the new ways of thinking about what it is to interact with a computer that these scenarios can inspire and support. The notion of a computational thing as a "display" seems to limit what spatial appearances we can create. The notion of "ubiquitous information" and the extreme scenario described above, however, implies that these limitations are rather illusory.

4. Aesthetics:

When we want to find out more about the intrinsic expressions of computational technology as material for design, we sometimes have to disregard functionality. Instead of asking what the use of thing is, we can ask for what it expresses. As we disregard functionality, we often have to design for settings not typically associated with work. Within a work practice most instances of computer use will be defined by its use as tool.

This difference in what is considered valuable or interesting became evident when people used the displays and devices presented here in real-world settings. At the art museum exhibition, most people appreciated the installations and found that they opened up new perspectives on what human-computer interaction might be like. In the office setting, however, there were frequent complaints about the

lack of clear functionality. Both reactions are plausible given what activities these two different kinds of environments are designed to support, and as interaction designers, we have to work with both kinds in order to broaden our understanding of interaction design.

If we do not try to hide the technology behind the smooth, nice and tidy surface that characterises most electronic products, we can expose the technology itself and encourage people to reflect upon its workings. Not focusing on the surface of the interface itself also forces us to consider the design as a whole – we do not just give the technology a certain interface, but form a coherent expression that is consistent throughout the design and not just on its surface.

7 Concluding Remarks

The expressiveness of computational technology as design material concerns ways of building temporal structures using a wide variety of spatial building blocks. Slow technology can then be thought of as a program for exposing such structures in various computational things and thus exposing basic aesthetical properties of the computational material building these things.

We will continue the experimental design work in the direction pointed out by these leitmotifs to gain more experience as a basis for further reflection on the aesthetics of computational design material. Both in the concentration on form as "time gestalt" and in working with a sort of "abstract" material we see connections with musical composition. We will try to follow this line of thought and in future experiments more consciously and systematically merge "design" and "composition" in the experimental design of computational things.

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