DESIGNING FOR UTILIZATION

PUTTING DESIGN PRINCIPLES INTO PRACTICE

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ABSTRACT

Designers do not only create usable products for a predefined purpose, but also to explore new materials and technologies. In doing so, they should not restrict themselves to existing conventions, but develop new ones out of the medium at hand. These new interface forms should encourage users to appropriate an object for their own purposes – i.e. utilize it. In this paper, we will describe the development of a fabric interface prototype that should exploit the material and encourage utilization of the interface. We discuss how our theoretical perspective was translated into a concrete design, and how appropriate we judge it for utilization. We conclude that design without final goal is surprisingly hard to do, but can show the value of the medium used.

INTRODUCTION

Since the 1980s, it is widely agreed in design that the aim of designers is to create usable, desirable and useful products – that is, things that people will understand and that will enable, empower or enrich them. Often subsumed under the term 'User-Centred Design' (UCD), various methods for analysis and implementation have been developed and successfully applied (Nielsen 1993; Preece, Rogers et al. 2002; Visocky o'Grady and Visocky o'Grady 2006). Today, they are often mentioned as best practice in design (International Organization for Standardization 1999) to ensure the comprehensiveness and meaningfulness of newly designed products.

However, there are not only limits to how well we can make a design fit with the user's existing knowledge. It is also an important purpose of design to introduce something new and unfamiliar to the world (Jonas 1993), which does by definition only partly relate to existing situations and behaviour. We feel that it is this playful 'exploration of the new' that needs to be emphasized more clearly in UCD methods.

Such methods would then need to focus not on problem-solving, but on possibilities, regardless of their immediate rational applicability. Instead of a readymade problem scenario, users would only get to see a 'solution' and have to construct the problem – the purpose of the artefact – in their own ways. The designer would then need to design **without a clear purpose in mind**, to leave the artefact open for interpretation and utilization, beyond the designer's original intentions.

It is only recently that this kind of reuse and appropriation has been regarded as a potential to be addressed by professional designers. The few examples and principles to 'design for utilization' are still about to be translated into design methods and processes. In this context, disruptive, surprising or ambiguous design has been proposed by different researchers in HCI and design as appropriate strategies to open artefacts for reinterpretation in use (Dourish 2003; Gustafsson and Gyllenswärd 2005; Gaver, Bowers et al. 2006; Höök 2006; Sengers and Gaver 2006; Dix 2007). This might e.g. be achieved by **creating discontinuities in a design**, like contrasting a soft form with a hard material (such as a pillow made of concrete, see Ludden, Schifferstein et al., 2008). By confusing the established meanings of a product, the user has to rethink them anew, possibly coming up with some original and surprising interpretations.

The translation from abstract (theoretical) principles to concrete actions and results has always been a challenge within design. In this paper, we will therefore present our 'design-for-utilization', an interactive quilt blanket, and its design process, to document this very translation. We describe the operationalization of abstract design principles into a design, report on the practical challenges during the process and reflect on the suitability of our approach.

THE DESIGN PROCESS: TRANSLATING PRINCIPLES INTO ARTEFACTS

For our design project, we translated two abstract principles into an actual object: one principle was to ‘create discontinuities in the design’ and the other was to ‘create a design with no predefined use purpose’. Both principles should lead together to an artefact that would be more open for diverse interpretations than purposefully designed artefacts. In the following sections, we will detail on the design process we set up to implement these principles, and unfold some of the decisions made in detail.

DISCONTINUITIES IN THE DESIGN

Discontinuities in a design potentially deceive a user’s understanding of an artefact by displaying unfamiliar or contradictory forms, functions or materials. Such unexpected and surprising features require a person to re-evaluate and reconsider an artefact, thereby stimulating exploration and utilization (Sengers and Gaver 2006; Bredies 2008).

For our project, we decided to create functional-material discontinuities in an electronic artefact by **choosing a novel material, and form, i.e. conductive textiles, for an existing electronic function**. Fabric items and electronic devices are both familiar from everyday life, yet a mixture of the two is still rare. The material qualities of electronics and fabrics are almost opposites: while fabrics are soft, stretchy and allow for imprecision, electronics are stiff, edgy, hidden away in black boxes, and require high precision. Additionally, fabric electronics have been developed only recently, so unlike more established areas, there are not yet any agreed conventions for textiles as an electronic interface material. Creating discontinuities by merging electronics and fabrics thus promised to lead to a reasonable contrast to familiar and existing products.

NO PREDEFINED USE PURPOSE

The purpose of an artefact results from the relationship of its use context, function and form. A bottle has a different purpose when it is used for holding precious wine compared to when it is converted into a Molotov cocktail. To translate our second principle, ‘design without a clear purpose’, into practice, we wanted to leave the specifics of the use context and function of the artefact as unanswered as possible. To start with the otherwise common analysis of context and user study was therefore not suitable for our project.

Instead, we chose to apply a method called **‘Rip and Mix’ or ‘Case Transfer’** that was developed by Chow and Jonas (2010) for this kind of open-ended design projects. It represents a structured approach to analogy-building, which is itself very common in design. Based on the idea that existing artefacts contain transferable design knowledge, the method starts with collecting such artefacts or ‘visual sources’ on swatch cards. ‘Local’ sources represent artefacts from the same domain and serve as a benchmark for the new design. ‘Regional’ sources have to come from a similar, not the same, domain – e.g., if the design goal is to create mobile phones, these sources could be mobile objects of all sorts. These sources are pointing to new forms, functions, contexts and purposes that can then be transferred. In the following sketching sessions, one or more features from those sources are used as inspirations and combined into a new artefact. After such a design transfer session, the results are sorted, evaluated and refined in the next iteration.

For our project we collected local sources from both electronics and fabrics domains . While for local electronics sources, we were mostly interested in transferring the artefact’s function, the local fabric sources should represent the variety of possible forms and interactions with the material. For the regional sources, we collected artefacts with a property similar to a fabric property, derived from a collection of terms on a thesaurus map. For example, a bomb shelter was part of the regional sources, as it would represent the property of ‘covering’, which was similar to ‘wrapping’ and ‘being flexible’.

We used the Case Transfer method in three iterations, in which we collected visual sources, created analogies in sketches based on the sources and categorized them to decide how to proceed in the next iteration (see figure 1).

Figure 1: A schematic overview of one iteration of the Case Transfer method

Figure 2 [top row]: Various prototypes for an unstructured textile interface

Figure 3 [bottom row]: Various prototypes for a structured textile interface

FABRIC INTERACTION

An important learning point in using the case transfer method was to determine what the distinctive properties of fabrics are. Such properties provide the greatest contrast with electronics and may therefore create the biggest design discontinuity. Through using the various fabric sources as inspiration we realized that those ideas that use the fabric merely as a substrate (i. e. not as an interaction medium) seemed less interesting. An example is curtains that light up when you close them in the evening. Ideas that used interactions inherent to fabrics (like crumpling, folding, tying or reversing) were more thought provoking and seemed to create greater discontinuities in the design. An example is a pair of bed sheets that, by the amount it is crumpled in the morning, determine your clock's alarm sound.

We explored these fabric interactions in two directions. On the one hand, we investigated rather unstructured fabric textile objects that solicit specific fabric interactions, similar to those with a sari, turban or papyrus roll (figure 2); and more structured objects that on occasion also make use of peripheral artefacts, such as a wallet or tool belt on the other hand (figure 3). We believe that both concept directions possess the potential to become utilizable designs in different ways. For our prototype we chose to continue exploring unstructured fabric textile objects since these allow for more different fabric interactions. These objects can also be prototyped more easily and reliably, as we found through our prototyping efforts.

ELECTRONIC FUNCTION

Folding and crumpling a fabric object can be linked to a large number of electronic functionalities, for example taking a snapshot, calling someone, communicating with a social network or controlling a television. When reflecting on which functionality to select, we realized we found it important to couple the functional feedback directly with the fabric object, in order to overlap action and perception space. We wanted to avoid a big gap between action and reaction over space as well as time, as it would have been the case with for example connecting the object to an online social network. We also valued a functionality that could be used in different contexts for different purposes, which ruled out e.g. using it as a television remote. Last it should be feasible to implement within a three month timeframe, not too heavy, bulky or energy consuming, and robust in use. This led us to select the functionality of sound recording and playback.

Recording sounds is a reasonably general activity to fulfil a myriad of purposes (e.g. note keeping, music mixing or diary) and is therefore open to a variety of use situations. It can be implemented with simple electronics and requires few hard and bulky parts. We also expected it to give easily perceivable feedback when users would explore the prototype without knowing its function.

BRIDGING INTERACTION AND FUNCTIONALITY

To make the fabric object work as a sound recording interface we would need to track the crumpling and folding of the fabric. As inspiration on structuring fabric objects we used the Japanese furoshiki. A furoshiki is a cloth that you use to wrap gifts, home accessories or items for transport (Ho 2009). The folding and knotting thus adds structure to the otherwise loosely structured fabric. This inspired us to use the structure created by folding the fabric as part of the interaction.

Despite the general openness to utilization, the user should still be able to discover the electronic functionality. Accordingly, we searched for a meaningful way to provide subtle information about the interface's workings. Therefore we used patchwork patterns as a symbolic way to structure and communicate the interface functionality. Patchwork is a traditional technique to structure large fabric surfaces into patterns, with a rich repertoire and its own history of meanings. E.g. it is a popular myth that patterned quilts were used as road signals on the Underground Railroad (a 19th century network of slave escape routes in North America, Schmeh, 2009). This inspired us to use the patchwork pattern to communicate the interaction that accesses the electronic functionality.

THE FINAL PROTOTYPE

The resulting design, shown in figure 4, is a patchwork blanket of roughly 1,5x1,5 meters. When folded together in different ways it triggers the recording and play back of eight different sound samples. The patchwork pattern hints to ways to fold the quilt that create effective electrical connections. Twelve magnets distributed in the quilt are used to detect the way the quilt is folded. The electronics are in a detachable pouch on the backside in which the circuit is distributed over seven layers of fabric.

Folding the quilt in such a way that corresponding coloured fabric strips match up records or plays back one of the eight sound slots (figure 5). The way the centre of the quilt is folded determines whether you record or playback, and the folds in the periphery of the quilt determine which of the eight memory slots you access.

To determine which of the twelve magnets make contact, we connected them to six different voltage lines and six analog input port lines. The combination of voltage levels arriving at the analog ports encodes the folds in the quilt. To ensure that the voltage lines can only connect to the analog lines in the quilt, the connection points were fitted with opposing polarity magnets. Dollops of conductive yarn, in the middle of the magnets piercing through the fabric, make contact only when opposing polarity magnets attract, as shown in figure 6.

Figure 4: The final prototype of the sound recording quilt

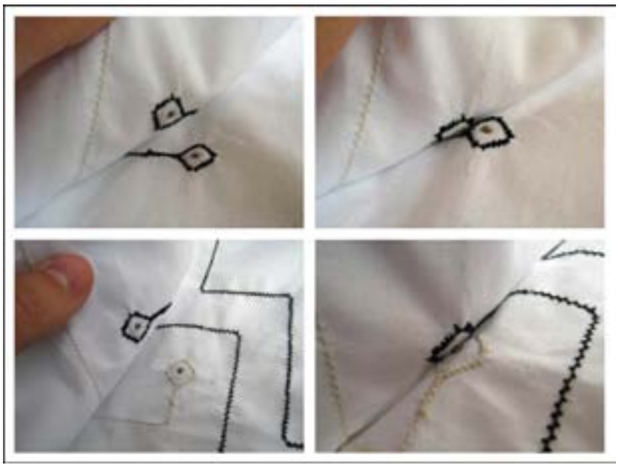

Figure 6: Connection points unable to make electrical contact (top) and making contact (bottom) in a test prototype

DISCUSSION

In our project creating discontinuities with a novel material resulted in all the difficulties inherent in the combination of contradictory materials: unreliable connections, shortcuts, troubles with the high resistance of the conductive thread, long and tedious troubleshooting and problems to establish well-working production methods within reasonable time. In many cases, we had to compromise on our intent to replace standard electronic elements with fabric and use either sturdy fabric accessories such as snap buttons, or fall back on the original electronic component such as shielded wire to carry the audio signal.

Through this challenge of combining contradictory materials we created a design that can be interpreted in different ways. In its visual appearance, material and style, the patchwork pattern appears as a decorative pattern, being made with traditional prints and fabrics and established pattern techniques, while at the same time, it provides clues to the sequential interaction of recording and playing back sound samples. The shape of the patchwork, without the removable electronics, could be used in many ways, e.g. as a bed spread or wall decoration.

Figure 5: The prototype folded together to record a sound sample

The magnets, incorporated to ensure a good electric contact, can be used to hold magnetic objects or attach the blanket on magnetic surfaces, such as storing notes on it with kitchen magnets or using it as a key rack.

Whether these opportunities to use the quilt in different ways invite exploration during use still needs to be empirically evaluated and is part of ongoing research. However, we believe that the complexity of possible interpretations makes the prototype suitable for utilization: the interface definitely offers more interactions than a traditional sound recorder, and is unconventional enough to require users to interpret and experiment with the quilt.

CONCLUSIONS

In this paper, we described how we translated two abstract principles into concrete design actions. The aim of the presented project was to create an interface that would invite utilization. We defined two design principles, namely 'design without a predefined purpose' and 'create discontinuities in the interface' to help us achieve this. We used the 'Rip and Mix' method to translate these principles into a design process, creating functional and formal analogies with fabrics and electronics as design mediums and inspiration and determining various use contexts based on visual sources. The result is an interface prototype that juxtaposes the contradictory qualities of fabric and electronics, and can be used as both a fabric and electronic object.

CREATING DISCONTINUITIES

We propose that our approach – to create discontinuities on a material and functional level – was an appropriate translation of the principle because the resulting sound recording quilt challenges both its identity as a fabric and electronic object. In appearance and material, the quilt encourages handling as a fabric object. The electronic functionality can be discovered through that use, thereby providing a discontinuity in the users understanding of the artefact as a fabric object. Further studies are necessary to investigate if this discontinuity is perceivable in use, as we expect it to be.

In the use of the Case Transfer method, we had to be explicit about the kind of discontinuity we wanted to design. Collecting the visual sources and analyzing the idea sketches proved to be a quick and thorough way to define the discontinuity that we believed to have the most potential: exploiting the interactions inherent to fabrics – and complementary to electronics. During the design process the reconciliation of contradictory material demands forced us to come up with new interface elements and interactions. Bridging fabrics and electronic gave us opportunities to create design discontinuities and the case transfer method help in this process.

NO PREDEFINED USE PURPOSE

We learned that 'designing without final goal' is not a straightforward and common process for designers, probably because any purpose – as open as it might be – is a prerequisite for further design decisions. However, the case transfer method helped us to generate design ideas for fabric electronics while leaving much of the purpose open and finding new purposes along the way. We suggest that our indecision with regard to the purpose, combined with physical prototyping throughout the project, enabled us to discover the possibilities and limits of combining our two contradictory media freely.

In our case, designing without final goal made us realize what the intrinsic values of the selected materials were. Therefore, as a translation of our principle, we believe that our approach is particularly suitable in designing products that explore the potential of a new technology: projects with no final goal.

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