

FABRICATION

BY CREATING DYNAMIC PATTERNS

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Biography

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SUMMARY

In this paper we describe our experimental work with dynamic textile patterns. We question how information can create an aesthetic pattern or how an aesthetic pattern can reveal subtle information. We have worked with generating different kinds of textile samples in which dynamic patterns can be used for experiments with aesthetical issues. We have made two concepts 'a bag for the mobile phone' and 'an apron for the PDA'. We use information technology as an active part of the pattern, not only when constructing it, but also during its use.

ABSTRACT

In the project 'Fabrication' we investigate how information, and computer technology, can be an active part in aesthetic textile patterns. We work with different fabrics as well as different ways of creating dynamic patterns. We are doing this by integrating information technology as an active portion of the fabric, not only when creating a fabric but also during its use. Just as threads build up fabric, information technology is building the pattern upon the fabric. Dynamic patterns, which can change over time, can be used as a tool for communication, they can visualize more and other kinds of information than a technological product itself does, in a more slow and

¹ <http://www.play.tii.se/projects/itextile>

subtle way that takes some time for one to get to know and interpret. The paper describes experimental work of exploring how we today usually create, use and look at aesthetical patterns, and how this might differ when designing dynamic patterns.

INTRODUCTION

Communication through aesthetic textile patterns

We want to question existing codes for what is defined as aesthetic decoration and what is defined as information. Why is there a difference? Often information is clean and undecorated; it is the message that is most important, not how you receive or look at it. On the other hand, when we generally speak of the aesthetics of decoration it is often the other way around; a pattern or decoration often doesn't have any other meaning than being just a decoration, beautiful and pleasing for some people and ugly, displeasing, for others. Perhaps you can compare that with information that can be of great importance for some, and not useful at all for others, for example: the person next to me doesn't necessary have any interest to know whether my mobile phone is receiving some data, however she/he hears the beeping phone.

In 'Fabrication' we want to explore how aesthetic decoration and information can work together. We want the decoration to involve information but not only in a static or pre-designed way. We believe a good way of working with these issues is not to work with parameters of beauty or effectiveness. Information and aesthetical components can lack each others properties, and so we will not try to couple beauty with information, or effectiveness with patterns. Instead we want to avoid designing with a focus on aspects of taste or opinions. We want to emphasise aesthetics as a lens for the information, and we want to emphasise that the aesthetics in this case does not have to be a matter of static decorative patterns, rather something dependent on time and use.

We want to explore the expressiveness of a combination of textiles, electronics and computing technology, therefore we are working experimental, both with different techniques and applications. By trying out we explore the different possibilities of combining information with aesthetics and use.

FABRICATION

Fabrication in one sense.

Early computer programming evolved along with the use of punch cards for weaving and knitting machines. The punches informed about which threads should be used which in turn determined the order of a process. One was able to use computer technology not only to instruct the machines how to weave and knit cloth, but also how to weave and knit patterns. The cloth and patterns were, and generally still are, fabricated once and then used as is. We want to extend the lifecycle of the computer program that constructs the pattern. The program will not be executed just once during the existence of the textile, but will constantly run even after the fabric is produced. Therefore it will have the ability to alter the pattern continuously; *we will fabricate continuously*. This means that until every possible situation of use has occurred, the picture is not complete. Our work therefore deals with questions concerning what difference this makes when designing patterns; what's the difference of designing a static pattern and one that is continuously fabricated?

Fabrication in another sense.

We want to explore how patterns can reveal information. The patterns should therefore appear and disappear, grow and change depending on what kind of information we want to visualise. We want to create the patterns in a way so that it is up to the viewer/user/participator to interpret the information, since we think that this is the most interesting way to work with the aesthetics. The information we want to visualize doesn't necessarily have to be something that really exists and it is up to the viewer to decide what she/he will believe, therefore the pattern can sometimes be a fabrication. A concrete example of this is given in a design example, further on.

The Pattern

Since we want to explore how an aesthetic pattern could work as the visual part in the communication process we have to question how we today typically create, use and look at aesthetic patterns. Patterns are often used as a decoration and can for example stimulate feelings associated with an upcoming event or feast such as Christmas, Chanukah, or Midsummer. A pattern on a table cloth can also indicate something more; for example how the table cloth is meant to be placed. In the early stages we created a table cloth that was falling off the table if it was placed in a symmetrical way with the aesthetic pattern in the "correct" position.



The falling table cloth.

The table cloth has a squared pattern as a border around it but the squares on one side are heavier as they are made of mosaic stones, and not printed with swell paint, as the others. Both sides of the table cloth look similar so when placing the cloth on the table, with a symmetrical placed pattern, the table cloth will slowly fall off the table. In order to keep the table cloth on the table, it must be placed on the table in an asymmetrical way, with one border placed on top and a long piece of cloth hanging to the side of the table.

The Material

Since we want to create fabrics that change patterns from time to time we work with combining textile materials with dynamic properties, - such as thermochromic, electroluminescent and conductive materials, - with more traditionally materials like for example cotton. We are experimenting with screen printing, hand woven samples, embroidering and different kinds of applications to find a way of creating dynamic patterns. Below we show some initial experiments with the different materials.

Different ways of constructing a pattern and the process of creating

When thinking about textiles with aesthetic decorative patterns, it is important to consider how people will feel about specific textile materials. The colour can for example remind them of their childhood, the flowers in a pattern can remind them of their grandma's kitchen, or the smell of the fabric inside their first car. It is hard to say what people will think or feel when looking at patterns, some like them, others do not. It is dependant upon experience, culture and even the fact that how we look at "the same" colour differs from person to person [Nilsson 1999]. When looking at a design, the aesthetic often is built upon colours, shapes, symbols and different kinds of materials. When looking closer one can see that the structure and the tactile qualities also have their own language. And in addition, aesthetic decoration can be even political if the pattern communicates a message (with symbols or words).

We will try to sort out how aesthetic patterns can be constructed and built up, not only when the fabric is created, but also during use of the fabric, so that the pattern can be constantly changing.

A static pattern

Most textiles in our surroundings have a static pattern. A fabric is designed with one pattern that is more or less permanent; it does not change its appearance, except for tearing or stains that may occur. A static pattern is produced either by weaving or knitting or by textile printing.



A static pattern (Golden Bough by William Morris) that is designed before weaving the fabric.

A dynamic pattern

A dynamic pattern is a non static pattern that changes with respect to context of use. For ex. in the work 'Information curtain' [Melin 2001] the fabric is made out of photochromical treated threads and the curtains change colour from white to coloured when the sun rises. So a dynamic pattern can react upon existing information in the surroundings. But, the pattern is still designed before weaving since one pattern is designed for the situation when the textile is exposed to uv-light and another pattern when it's not. So, it is a dynamic pattern in the sense that the fabric can change its pattern, but, it can only shift between two static ones.



A dynamic pattern. During night the curtain is white and when sun rises it reveals a colourful striped pattern.

Aesthetic information pattern

With aesthetic information we mean a pattern that is created influenced of some form of information. Aesthetic information can concern both static and dynamic patterns; we will explain this further with some examples.

Aesthetic information in static patterns

When creating static patterns with aesthetic information, information is used as inspiration with the purpose being that the decoration is something more than just a decoration. An example is a pattern made by the group Saldo² where the pattern is a textile with dots printed in swell paint, the dots is in blind Braille alphabet and describes the experience of a colour. Another example is the pattern below, where the pattern is based on information about democracies, dictators and refugees in the world. The aesthetic is built up upon this information and the fabric can be read as a diagram.



A static textile pattern (State of the world, by Saldo) but with aesthetic information.

Aesthetic Information in a dynamic fabric

By using a dynamic textile (ie. a fabric made out of photochromical threads) as a display, patterns can be written over and over again as in the project 'Using Color-Changing Textiles as a Computer Graphics Display' [Holmquist, Melin 2001]. In the project a computer controlled uv-lamp was writing the pattern upon the fabric, over and over again.

Another example where the information is used as a "pattern maker", or as something that reveals the pattern, is in 'The Interactive Pillows' [Melin 2003]. In this example a pattern is already "hidden" in the fabric and can be revealed depending on specific input, in this case by leaning against, or hugging one of the pillows in the pair. The pillows are textile objects communicating with each other and the surroundings.

² <http://www.saldo.com>



A dynamic pattern with aesthetic information, 'The Interactive Pillows'.

Using time as a central parameter is another example of how a dynamic pattern can be made with aesthetic information. This is done in the project 'Draft', an ongoing project at PLAY Research³. In 'Draft' the pattern is less pre-designed than in the earlier examples and works as follows; a table cloth is slowly pulled down in the center of the table during a meal and when the meal ends a lamp will activate a pattern on the fabric underneath the table. When pulling up the table cloth for the next meal, the table cloth receives batik like pattern. So, the more colourful and large the pattern is, the longer the meal before was.

International Fashion Machines (IFM) has done color changing textiles that are meant to be hanged on the wall *"like any other piece of art, but unlike other artworks it magically changes color and pattern over time"*⁴. The textile can be seen just as art or it can be combined with their textile sensors so that the patterns can change depending of what the viewer does with it.

Spurred by the experience and knowledge of these different projects and prototypes, we decided to do 'Fabrication'. In this project we don't want to work with external "pattern makers" like in the 'Draft'-project, where an external lamp creates the pattern. We want to create a pattern that changes over time, and a less pre-designed pattern than the patterns in the examples above, less pre-designed then the patterns made by IFM for example. So, depending on context, situation and mood, the person herself/himself will affect a fabric in constant change, in a way where the aesthetics will not only concern colours and shapes but also interaction and use. As in the examples above, some parameters are still decided during the making of the fabric, but these parameters will be handled with less control over how the aesthetic expression will appear, we want to leave that up to the person that wears, tears and uses the technology. The pattern will be created both by interaction with the actual object and by use of the information flow in the personal space.

³ <http://www.play.tii.se/projects/itextile/draft.html>

⁴ <http://www.ifmachines.com/>

Textile materials and techniques

There are some different types of materials on the market today that can be used to make patterns appear and disappear, it can be done for example using chromical materials, also called Chamelont fibers. There is a range of different Chamelont materials;

Photochromic where stimuli is light

Thermochromic where stimuli is heat

Electrochromic where stimuli is electricity

Piezochromic where stimuli is pressure

Carlschromic where stimuli is an electron beam

We haven't gotten hold of all these different materials and all of them aren't used in the textile field yet. The chosen Chamelont fiber for this project is thermochromical screenprint paste. The property of the material is a colour change when the material is heated up. Temperatures around 37 degrees Celcius initiate a colour change, so the fabric can be heated up by hand or breath. When the heating source is removed, or switched off, the fabric slowly changes back to its original colour.



Thermochromical table cloth where the lighter circles comes from different cups of tea.

To get a better feeling for the possibilities of these materials we made a table cloth with thermochromical screen print. In this experiment we used external objects such as a hot tea cups to generate patterns on the fabric. We made a small exhibition in a café where we placed the table cloth for a few days. Some people started to play by creating patterns while others chose to not place their cups at all on the table, perhaps they didn't like to leave traces or were afraid of staining it.



Pigmented thermochromal screen print.

Further on we made experiments where we mixed pigment into the thermochromal paint. Instead of just getting a white colour when the fabric was heated we could decide which colour that should appear. We mixed colours that seemed to make an interesting combination, colours that should work both separate and in mixture. We found out that by working with variations in the intensity, of the colour, we could achieve a wide range of different expressions.

The next step was to integrate the heat element directly into the fabric, so that we could control when and why the colour changing should take place in a more subtle way. We came up with different methods for how the heat elements and the conductive yarn could be integrated in a fabric and made samples on basis of the following ideas:



Conductive heat transmitting threads sandwiched together with fabric.

Different fabrics in layers can be sandwiched together with heat elements in between and a screen print with thermochromal paint on the top layer. In the example shown in the picture voltage is turned on, that's why striped forms are appearing. In this example we used a metal wire as heater, a kind of thread that is used for example in toasters.



The pictures show a blue thermochromical print made on conductive fabric which has metallic wirers stitched on the backside.

In this sample we printed onto a carbon fabric, the field between the metal pieces is heated when electricity is turned on and therefore a colour change will appear on the surface printed with thermochromical screen print. The shape of the pattern depends on what voltage the wires receive.



Conductive film can also be used as a heat element attached to fabric with a thermochromic screen print. The conductive film on the picture is taken from a laser cut sole fore ski-boots.

By making a weave with conducting wires within, a thermochromical print can be made onto the fabric, or the weave can be sandwiched together with thermochromical fabric.



The conductive materials as heat elements are integrated directly into the fabric during weaving.

We have experienced that there is a quite big difference between designing a static pattern and designing one that can be built up in a material with dynamic properties. One way to look at designing dynamic patterns is to look upon it as designing different layers. The layers must be designed such

that they can be viewed separately, but also be combined over time. In screen printing all colours have a separate layer and a separate frame, and together they build up the pattern, but, with dynamic patterns all layers can be seen separate and combined with different other layers. Hence, with a dynamic pattern each layer needs to be interesting in itself and in combinations with all of the other layers. Designing these kinds of patterns also bring questions about how much control of the pattern that should be given to the user of the fabric.

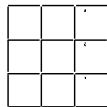
These new materials provide new opportunities for creating/designing aesthetic patterns, where the aesthetic pattern involves information. So this is both about new ways of sending out information and new ways of creating aesthetic patterns.

EXAMPELS

How we create an aesthetic information pattern in a dynamic textile

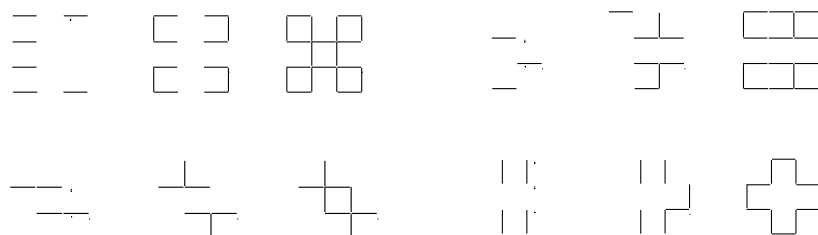
When we had explored how a dynamic textile could be made, the next step was to investigate how to make patterns with these materials and fabrics. As mentioned above these dynamic materials open up new possibilities for creating patterns compared to designing static ones.

We looked at how rather basic and traditional patterns like stripes and squares could be separated into different layers, and how the layers could be combined. We were able to change a pattern from a rather asymmetric image to a symmetrical one, with stripes and squares, and back again.



The embroidery

We wanted to take advantage of the possibilities the input can give, so we made an embroidery where one could activate different stitches from time to time. The first testing platform, with embroidered heating conductor, was made with 9 squares with the ability to control every side of every square. The embroidery was placed beneath thermochromical textiles to test out different textile patterns. The embroidery works similar to an old calculator display.



Different examples of possibilities with the embroidery

We haven't only been experimenting with different ways of making patterns, but also with different fabrics and with different combinations of colours, for example to see how long they preserved colour changes. We found different expressions and built up a collection consisting of an apron and a bag.

The Apron is to be found in just one fabric that can shift in three different distinct colours.



The fabric for the apron is grey when not heated, lime when warm and red in between.

The Bag can be made in three different fabrics, one grey that can shift to pink, one red that can shift to light blue, and one brown that can become lighter green.

We think that a good way of working with questions dealing with designing dynamic patterns is to work with concrete design examples. Working in this way we presume that we will face concrete issues regarding design of change, issues we wouldn't face otherwise. By a concrete design example, we mean an example where we can work with the aesthetics in the pattern concerning:

- which input should reveal/change what pattern
- what the reveal/change will express and to who
- how the pattern and expression will change over time
- whether the receiver of the expression can influence the dynamic pattern

We want to illustrate aesthetics as the bearer of information, and how they are related. If we wouldn't regard these aspects, we would be heading towards a common computer display, a display that can show a lot of different things, no matter what they are, but in more or less the same way.

Accordingly we describe two design examples below and tell which kind of expression the chosen information should give, and what kind of information the expression will bring forward (cf. "expressions bring forth functionality" and "functionality explains expressions" [Hallnäs, Redström 2002]).

Design examples

Our examples are made with the intention to be accessories to a mobile phone or to a PDA. This means that it is not you who will be the most important wearer, it is not your accessories, instead, it is your phone's or your PDA's accessory. The main purpose is not giving you the ability to express something to your environment, it is to give your mobile phone or PDA a chance to express more of itself to you. We have been working with two different ways of building/creating a pattern that we show in our following examples: the bag for the mobile phone and the apron for the PDA. In the first example we are working with aesthetic aspects like plainness and order, in the second one with wear and tear and, more or less, uncontrolled disorder. Still, common to both examples is ambiguity, cf. [Gaver et. al. 2003].

The bag

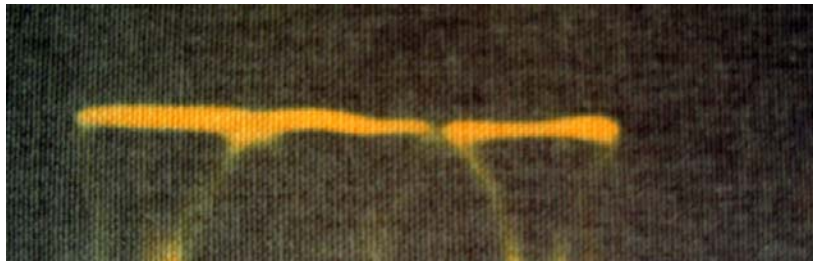
The bag is a rather small bag that you can use to carry things, as with other bags. But it can also be an accessory to your mobile phone. When the phone is placed in the bag, a pattern will appear on the bag if the phone receives or sends data. The pattern will appear not only if the phone receives or sends calls, SMS, MMS etc. but also when it is connecting to a base station either for checking which base station it belongs to, if it will be handover to another one, or to send information about the user's telephone company subscription. Our goal in this design example is to create a pattern that the bearer of the bag can learn to interpret, but only to a certain degree.

There are three common ways to notice a mobile phone call: to hear the sound of the ringing phone, to feel or hear the vibrator or to see the display if both the sound and vibrator are switched off. In all three cases it is the technology that decides if you will notice the call or not. We want to, as much as possible, let the mobile phone user decide if it is a call or not. Our way of doing this is to work with the expression of the bag pattern.

Imagine a situation where you don't want to be disturbed by your mobile phone, but you don't really think it's necessary to switch it completely off

either. You choose to make it silent and you allow the phone to use the bag to express its activity to you. The pattern on the bag will change slowly and subtly depending on how much and how often the phone receives or sends data. (This is done by measuring frequencies near the mobile phone.) The ambiguity here is important, you can't be totally sure if the pattern depends on the reception of a phone call or if just common data is sent to the base station. Therefore it's up to you to decide if you believe that what you see is something you want to react upon or not, a decision that certainly will be influenced by the situation, and the context as well as your mood and wishes.

The bag is, in the first place, the phones accessory with you as receiver; it is not primarily yours for expressing things to your surroundings. This is due to the fact that the pattern can tell something to you while others may just look at it as a common decorative pattern (cf. the dress made by Megan Galbraith that express time to the wearer in such a way that it is indiscernible to other viewers⁵).



A first try, making pattern with the matrix.

Due to the kind of information that will be expressed in this design example, and due to how we want the receiver to be able to choose, the pattern has some aesthetical requirements:

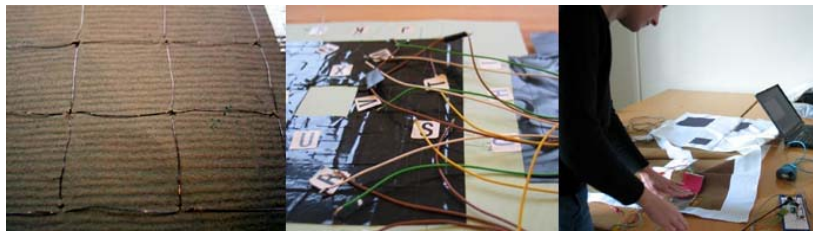
- The pattern has to be able to appear as well as disappear, which means that it shouldn't just grow bigger and more colourful all the time. So when the phone is removed from the bag a "starting point" pattern will appear after a while, in our example it will be just a single coloured area.
- The time is an important aspect. The appearance and change of the pattern can't be done too quickly because the observer shouldn't have to watch the bag all the time to be sure not to miss an event. The pattern will therefore not only show happening activities but also, is some extent, happened. Similarly it can't change too slow either, since that could mean that nothing longer could be

⁵ <http://acg.media.mit.edu/people/megan/elroy/index.html>

interpreted as a present event. (Another aspect is how much changing patterns we actually can handle in our surroundings, we don't want annoying twinkles.)

- The visual ambiguity has to be balanced in a way so that the observer will be able to see tendencies rather than actual occurrences, and also be able to get a feeling for which kind of information that is being presented, after some time. So the pattern on the bag can be interpreted as something that will be developed, you could be given the feeling that something is happening, and in a minute or two you could perhaps tell what.

We used a single coloured fabric, (heavy cotton) on which we made a thermochromical screen print. The top layer is attached to another layer with the conductive and heat emitting matrix embedded inside of these two layers. In this way we can make the pattern appear and disappear, over and over again. The chosen thermochromical material fades away when the voltage is switched off. After about ten minutes (depending on which pigment is used and the surrounding temperature) the original colour is back and the pattern will disappear into the fabric. Depending on the frequencies surrounding the mobile phone, the supplied voltage to the heating threads will be switched on and off, controlled by a computer program.



Embroidery made of conductive wires, each section controllable by the computer program.

The apron

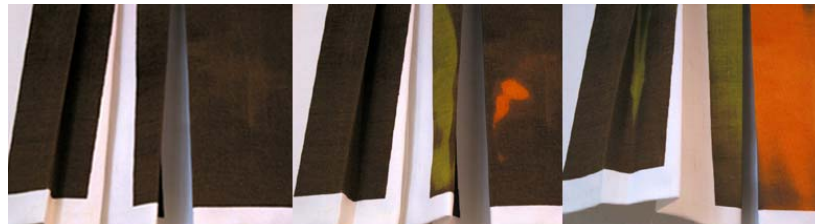
The apron is from the beginning single coloured. But, as an accessory for one's PDA, it expresses wearing and tearing, and not primarily the wearing of the apron, but the wearing of the digital material within the PDA. The more one uses the software, for example saving and accessing data, the more the apron will be worn down. A pattern will slowly appear, growing from time to time, piece by piece, and will never be exactly the same or disappear. This will be fabrication, since the apron will be worn by something that can't really be worn, the digital information within the PDA. The use of the apron can be seen as a comparison between how traditional textiles usually are worn and the fabricated wearing of the digital information.

The aesthetical requirements for the apron are therefore:

- The pattern must be something that can continuously grow without disappearing, much like how a well worn pair of jeans reveals a pattern.
- The fabric itself should be worn quite easy so that the apron will grow older even if the voltage is switched off.
- The pattern shouldn't be something in order, it should rather be patchy.

These requirements have been considered while experimenting with colouring textiles and while developing the shape of the apron. The apron have two separated fabric layers, one at the bottom with heating thread and one above with the thermochromical fabric. These are separated in that sense that they will get contact depending on how the wearer of the apron move, sit, wipe his/her hands on it, and so that a more or less unpredictable pattern will appear. The apron is draped and coloured in a way so that the colour of the fabric will get easily worn at certain places. The colour can shift between three distinct colours, dark grey, red and lime, and the red colour that appears while medium heated stays for more than half an hour in room temperature which make it easier for us to maintain the pattern so it doesn't too easily become less.

There are a few issues dealing with ambiguity, and not necessary bad ones. The measurement of 'digital wearing' can for example be done in several different ways, but it isn't really important that it is done in a completely flawless way as long as it done in any sense. The intention is not that you as a bearer will be able to see exact how many minutes you have used your PDA, the intention is that you will get a feeling that the apron is getting worn not only because you wear it as a garment, but also because you wear your PDA.



The pattern (on the apron) in different sequences.

We will be able to maintain the pattern by using a computer program that pulses voltage on and off to the heating threads in the apron. This means that we are dependent on power to maintain the pattern but by working

both with the power dependency and the wearing of the actual fabric in the garment we hope to find an aesthetical mix that can illustrate our point.

CONCLUSION

In 'Fabrication' we have experimented with different ways to create dynamic textile patterns through the exploration of textile materials and constructions. We have chosen one specific technique for creating dynamic patterns: screen printing with thermochromical paint, sandwiched together with heating elements integrated into the fabric, or placed in between. Other techniques would very likely have illuminated different aspects. It is hard to elaborate upon which aspects without further testing, since the different techniques are highly connected with the overall aesthetic.

Both design examples should be considered just as design examples, meaning that they are examples made to exemplify a thought and a way of experimenting and testing. Therefore they are also a way of thinking and a way of working. They should definitely not be regarded as a first prototype of a commercial product. The design examples imply that their results, like thoughts, reflections and learning, could have been very different if we had chosen to do other examples (a dilemma quite hard to disregard if you are doing research through design).

We think that computer technology should involve new or more alternative ways for how it can be used. It is often used just to control things, but it can also expose, create and be controlled by.

In our examples and experiments we have used power outlets and quite large batteries. The power is a problem but we think it's (almost) ok to work in this way since they are just examples and experiments. In further work a better power supply should be investigated.

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