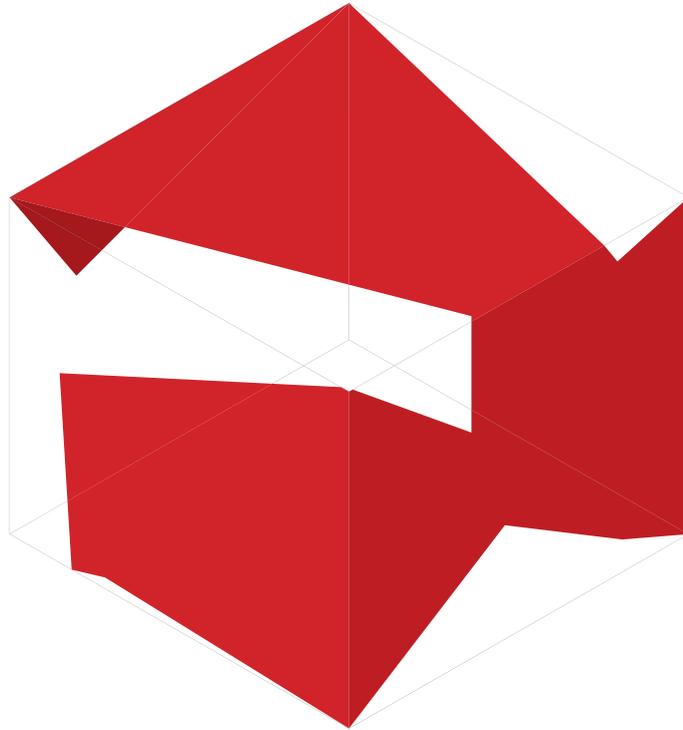


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An Interactive Textile Hanging: Textile, Context, and Interaction

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Abstract: This article presents three scenarios in which we explore different possibilities for interactive textile hangings, textile hangings that are knitted and attached to servomotors. We have identified a series of variables that address the relationship between the expressions of the changeable pattern, created by rotating motors, and the unchangeable textile pattern. We use these variables, combined with contextual dichotomies, to discuss the relationships between the textile expression, the temporal expression, the place and the interactions for these scenarios.

Keywords: Interactive surfaces, textile design, expressions of movement, space, interaction design

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Introduction

Textiles are often used to affect a room. Textile wall hangings, for instance, draw on a long tradition of decoration and story-telling where images are expressed in a textile language of interlaced yarns and colours (Albers, 1993). Alongside their aesthetic value textile hangings can also have functional purposes, e.g. to insulate or to improve acoustics.

We find the notion of textile hangings interesting because they give a sense of lived-in space. Their long history makes them recognisable in numerous contexts and they balance aesthetic and functionality in a way that makes them open to new interpretations. Moreover, by combining textile hangings with temporality - similar to that found in music or soundscapes (e.g. the use of music to catalyse shopping in supermarkets) - we are able to work with expressions that evolve over time – temporal expressions that can give a sense of a living and lived-in space.

In this project we want to explore the potential of interactive textile hangings. In particular, the role these textiles in giving a space a sense of belonging, connection or even meaning (c.f. Certeau, 1984; Augé, 1995; Dant, 2005).

Others have worked with interactive textile hangings or textile façades but from different perspectives. *Slow Furl*, for instance, is a project by Mette Ramsgaard Thomsen (2009) where she explores the use of textile logic in an architectural construction as well as the temporal dimension of architecture in movement. *The 100 Electronic Art Years* by Maggie Orth, on the other hand, explores the limitation of the technology used to create a temporal expression in the textile, here thermo chromic ink (Orth, 2009).

A challenge in this project lies in achieving synergies between the textile expression, the temporal expression, the context, and the interaction. Bergström et al. have treated this challenge as a matter of designing with 'becoming materials': "the term is employed to indicate both the material attribute of changeability within a given context and the continuous negotiation of the material expression directly or indirectly with the contextual factors in which it comes to be" (Bergström et al, 2010, p.158). We approach the interaction design task as a matter of developing expressions since "function resides in the expression of things" (Hallnäs & Redström, 2006, p.166). From the outset the material setup comprises knitted textiles and servomotors controlled by a computer, with various types of sensor input. We develop and explore textile structures, patterns, and scales in relation to the motors' movements and positions, and to possible contexts and interactions.

This article is an analysis of work-in-progress. It sheds some light on the interplay of these aspects. We show how together they contribute to insights that open up the design space and take the textile expression, interaction, or context in different directions. We exemplify the interplay through three different scenarios of interactive textile hangings.

The Textile

To develop an understanding of the expression possibilities in the combination of servomotors and textile surfaces we set up a series of explorations. The initial set-up consisted of up to 16 servomotors mounted to different surfaces. They were controlled from an Arduino board and, through a graphical interface made in max/msp, we could easily change the programme on the Arduino board and thus explore different expressions.

Beginning with some simple knitted textiles we gradually designed and tested a series of knitted geometric patterns at different scales. Through this process, we found different expression qualities - each with potential for different interactions and contexts. At the same time, as our ideas of interactions and contexts evolved they influenced the design of the



textiles and the motor positions and movement.

Through design exploration, we were able to identify different variables having an impact on the overall expression. The variables address the relationship between the knitted expression (i.e. The scale, shape, and direction of the pattern and the density, elasticity, and weight of the material) and its expression when exposed to the pattern of the motors' movement (i.e. their positions on the surface, the direction, the speed, and the angle of rotations). They are described here as dichotomies of textile expressions to show the span of possibilities. Or, illustrated through three basic design questions:

What is the relationship between the knitted pattern and the movement pattern?

In what way does the pattern of the motors affect the surface texture?

How is the direction of movement expressed by the knitted pattern design?

**Dominance: Movement
versus Textile Expression**

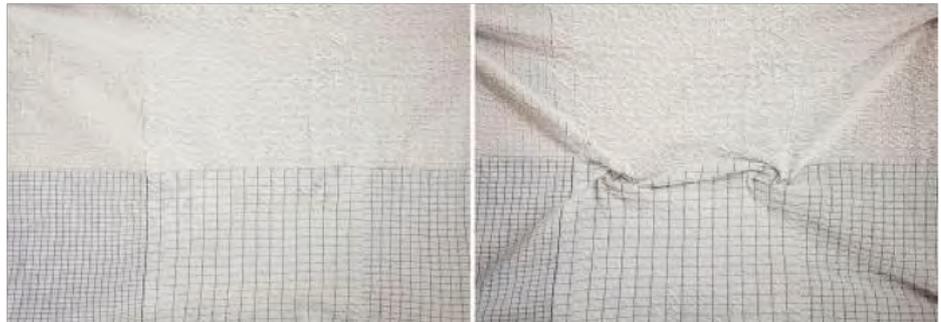


Figure 1. The movement is dominant in the overall expression.



Figure 2. The textile is dominant in the overall expression.

Dominant movement pattern - The textile is knitted on a circular knitting machine. The knitted pattern is on a small scale and the material is extremely elastic and dense. The motors are placed in a regular grid at a scale larger than the knitted pattern. The pattern created by the motors' rotations overshadow the knitted pattern, thus the motor pattern is the dominant one.

Dominant textile pattern - The textile is a structural knit made on flat knitting machine. The scale of the knitted pattern is large and the pattern is strictly structured. The construction of the material makes it highly elastic. The pattern created by the motors' rotations (in opposite directions) produces only minor changes in the textile expression. The movement pattern is subordinate to the textile pattern.



**Arrangement:
Regularity in the Temporal
Textile Expression**



Figure 3. An irregular movement pattern in both time and space.



Figure 4. A regular movement pattern in both time and space.

Irregular movement pattern - The textile is knitted in a structural geometric pattern. The motors are placed in a grid but their movements are uncoordinated and in opposite directions. The motor pattern distorts the knitted pattern and makes it appear in an irregular way.

Regular movement pattern - The textile is knitted in a regular pattern. The motors are placed in a grid and rotated in the same direction. The movement pattern is carefully positioned in relation to the knitted pattern. The motor pattern emphasises the regularity of the textile pattern.

**Direction: Movement and
Textile Working Together
or Opposing**

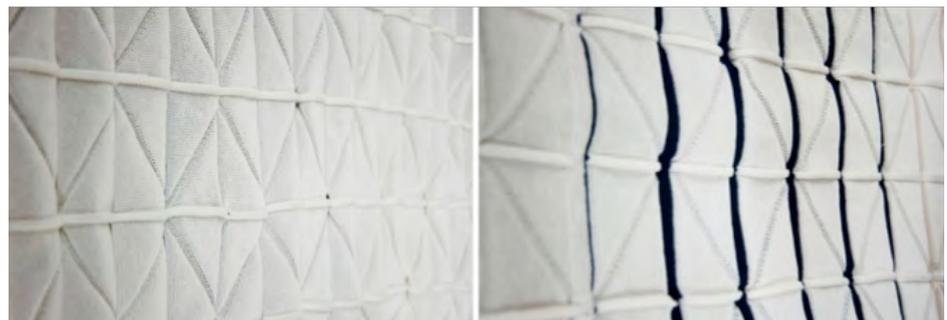


Figure 5. The textile and movements are working together.





Figure 6. The textile and movements are opposing one another.

Together - The textile is a complex geometric knitted structure. When stretching the textile surface in a vertical direction the visible shapes initially separate and reveal the coloured stripes. By letting the motors perform this stretch they work together with the textile structure and form an intentional and predictable pattern.

In conflict - The knitted textile is the same as above. However, the motor is positioned to rotate against the textile pattern. The result of this combination is a rather unpredictable pattern.

The Context

To illustrate the contextual dimension of the design space for the interactive textile hanging we articulated a series of dichotomies. Each denotes different spans of contextual variables that would be interesting to explore: picture frame scale v. façade scale; private v. public; ceremonial v. informal; co-located v. over a distance; individual v. collective interaction; and immediate v. delayed response. They have formed our common vocabulary for discussing the development of the contextual qualities of the textile expression.



Figure 7. The scale of space, picture frame scale v. façade scale.

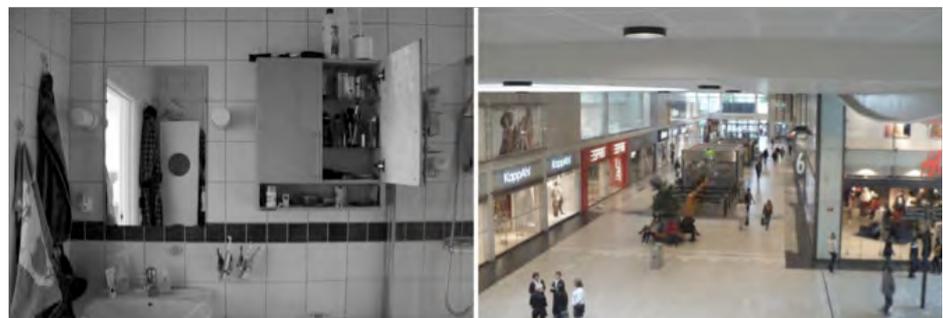


Figure 8. Private v. public place.





Figure 9. Ceremonial v. informal.

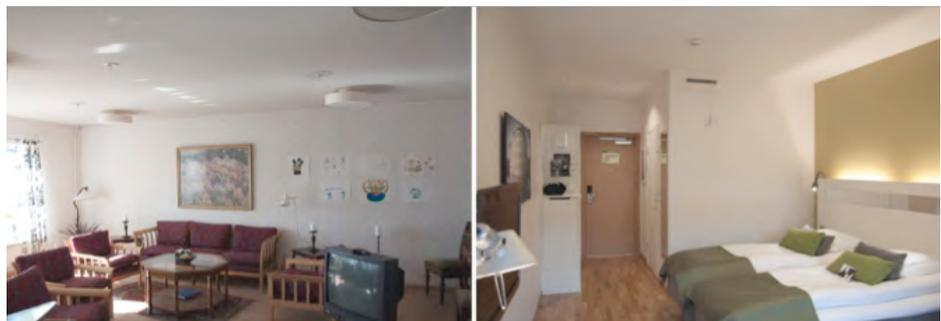


Figure 10. Co-located v. over a distance.



Figure 11. Individual v. collective interaction.



Figure 12. Immediate v. delayed interaction.

Choosing a Place

While exploring the potential of different materials and motor positions, we discussed which context to have as a frame of reference. Our choice was made from an interest of exploring certain interactions and spatial dimensions in relation to our material explorations. After an initial discussion of the dichotomies we visited four places: a hotel room (small place which is private yet impersonal, over a distance), an elderly home (a home away from home where you might spend years), a chapel (with a ceremonial and solemn atmosphere), and a mall (a large scale public place bordering on impersonal and mundane). We then discussed the differences and possible qualities of these places. For instance, in the hotel room you are often separated from the ones you know. It is a sort of non-place, private for a while but not at all personal (c.f. Augé, 1995). The elderly home, on the other hand, can often be the last place where you might live, without relatives. Your acquaintances might pass away. The chapel is a place where we say farewell to the dead, yet we cannot communicate with them. It might be an introverted action, yet shared with others. We chose the chapel.

Three Scenarios

Even though we had limited our design space through the choice of simple, small servomotors it was clear that the position of the motors - their direction, angle, and speed - in combination with the shape, scale, elasticity, and density of the textile could be combined and designed with very different results, in terms of expression. Furthermore, these expressions could appear differently depending on the scale, the societal setting and the activities of the place and how people might interact. Through our exploration, we envisaged a couple different directions in which expression and interaction could be coupled. To bring out these different directions – to not confuse them with differences due to context or activity etc. – we found it suitable to phrase three scenarios in the same context, i.e. the chapel.

Surface Distortion Message

The Textile

The textile veil extends in the central area of the space. The lightness of the textile softens the space. Its white translucent surface has no texture. The only texture that appears to viewers are fine, irregular folds that fall down to the pavement.

The Scale



Figure 13. Rendering of the textile in context.



The Interaction

The chapel, a funeral

You approach the textile surface.

It is big.

You are standing alone.

There are others in the same room but they are not where you are.

In front of the textile you say something.

The textile responds, the surface moves.

Something builds up in front of you.

Spreads out above you.

Moves away from you.

You remain in the room.

You look at the textile from a distance.

Sometimes you see movements.

Sometimes you recognise your disorder and order.

At other times you see someone else's.

The chapel, both at a funeral and at other times

You are not here.

You are somewhere else.

In everyday life.

Doors to open, systems to log in to and people to sort things out with.

You send a text message.

There will be movement.

Disorder and order.

There will be something in this place.

You are saying something in another way.

You will not see it.

It will appear.

You are here in your thoughts.

The movement

Stillness.

A slow movement, the folds start to unwind. Spreading. Unwind, wind.

Different directions. Meeting each other.

At shorter intervals, at some parts, a geometric clear structure appears to contradict the randomness of the first movement.

Stillness.

A new movement.

Stillness.

Ours change together. After each other. Echoing.

Random folds. Smaller structured patterns.

**Light Filter
Movement Mirror**

The Textile

Repeated segments of knit are interlaced. They form a structured textile surface. The segments are made to be parted and joined. The strict rhythm of the knits repeatedly arranges the space. The surface is light and regular and rather stiff. It is positioned in the back of the chapel, covering the glass wall towards the cloakroom.



The Scale



Figure 14. Rendering of textile in context.

The Interaction

The chapel, a funeral

We enter the room.

Behind us. Light from the outside filters through the openings of the textile.

The amount of light varies.

There is a moment when we haven't decided yet where to take a seat.

We move around a bit, nodding, saying a few things to each other.

Then we take the seats.

We are still.

The light from behind us reduces and rests still.

There is sound, but we are still.

There is activity, but we sit still.

At one point we stand up and take a few steps, one or two or three by three.

Then return to our seats. Light from the rear glisters slightly and disappears.

Sound. We all stand up and sit down.

Sound. We all stand up, walk towards and away from each other and out.

The movement

Our movements are reflected in the textile surface.

The textile is still when we are still. The textile is still when there is sound if we are still.

The textile is moving when we move. The textile answers to our steps. Patterns start to reorder. When we find our seats and stand up. With an increased intensity if we all move at the same time. Limited intensity if we are only few or move less.

When the textile is moving, patterns are revealed and concealed. Structures are formed and reformed. The surface will open up for light and then close, opening up other parts.

Affected by the collective.

The textile movement is one unit, with more or less.

A slow billowing surface.



Striped Turn Seed

The Textile

Curled stripes of knit are placed to form a path. The irregularity of the stiff and curled lines of the knit forms a continuous surface. Gentle winds continuously reposition the edges. The regular texture orders the overall expression in a closer view.

The Scale

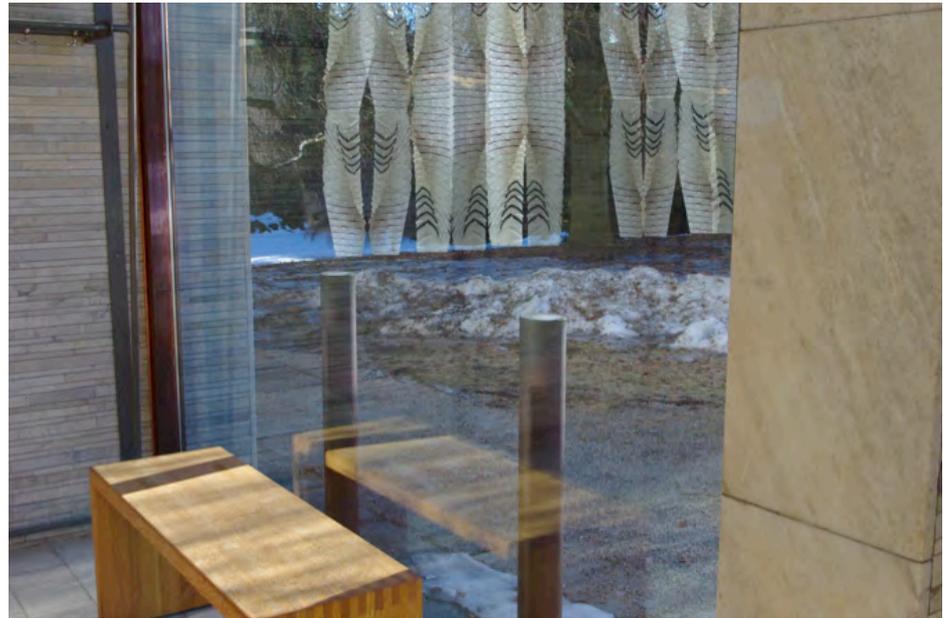


Figure 15. Rendering of textile in context.

The Textile

Curled stripes of knit are placed to form a path. The irregularity of the stiff and curled lines of the knit forms a continuous surface. Gentle winds continuously reposition the edges. The regular texture orders the overall expression in a closer view.

The Interaction

The chapel or similar nondenominational space

He enters the room.

To sit down for some time.

He is there as a way of thinking of someone.

Thinking.

Not thinking.

He does whatever he does there.

You are at a different place.

Between trees.

Walking.

At one place fifteen textile segments are lined up.

Together they create a wall.

A sudden change.

Different movements in all of the segments.

Spreading down and up and to the sides.

The movement quickly opens up the wall and keeps it open for a few seconds.

Opens up for the wind and you see through the wall.



You hear through the wall.
The leaves of last season.
A person's steps in the grain.
Then they slowly turn back to flat.
You know what created the change.

The movement
A twist.
The surface changes, the knitted lines start to bend.
The segment turns quickly in different directions.
Slows down before reaching its limit.
From order to disorder, from randomness to structure, the stripes reconfigure continuously in three-dimensional patterns.
Then the stripes go back with slow shifts.
To rest in their initial position.
Reconstruct the flat surface again.

Discussion

In the first scenario, surface distortion message, the textile is positioned in the central parts of the chapel. It will always be the background or foreground of the activities taking place. The movements, winding and unwinding, must be subtle enough to work in that setting, and yet strong enough to contribute something. We see the lack of texture and the irregularity in the arrangement of the movement expression as a way of doing this.

Moreover, the plainness of this textile provides the possibility of creating different, distinct changes of movement, which the interaction scenario requires. The movement can start at different places, spreading in different directions, and with different intensity, depending on the length, and content of the messages etc. The textile is predictable when it comes to types of change, but unpredictable when it comes to where the movement will happen.

In the first scenario the movement pattern is clearly always dominant to the textile pattern, which is necessary for the interaction and context of the textile. In the second scenario, light filter movement mirror, the movement pattern is less dominant than the textile pattern. The textile is made up of repeated segments with a clear structure. The segments are parted and joined by the motor movements, but the movements will not take over the textile pattern as much as in the first scenario. Both the textile and the movement pattern are regular which is directly reflected in the interaction and placement. This textile hanging is positioned as a light filter and is affected by the collective interaction of our movements. We have it behind us during the ceremony. It will be still when we are still but let the light fluctuate when we move, with corresponding intensity. Standing in the cloakroom it will spread the expression of the ceremony.

The last scenario, striped turn seed, is not co-located in the sense that interaction is only over a distance. Since the motors are attached to the fabric in another direction, each motor affects a much larger surface area than in the other scenarios. The larger scale of movement and the intensity makes it less appropriate for the interior of the chapel. This textile surface transforms from a flat to a three dimensional shape to a greater extent than the others. It opens up more, which gives it other qualities. The light filter movement mirror also opens up, but still works on a flat surface. The striped turn seed should stand in free space. The explicit changes work to catch the attention of passersby. You cannot avoid it even if it is in your peripheral vision.

There is a similarity in the first and last scenario. Both play with how the thought of someone can affect a textile surface positioned elsewhere. The difference is that in the first scenario you make a very conscious act of sending a text message. It is not important whether someone sees the change in the textile surface or not. It is just important for you, as the sender, that you can do something that will be substantiated somehow and that you can be there in your thought. In the last scenario, where a "seed" is planted, i.e. the person triggering the turning of the stripes, might be unaware or indifferent to the additional consequences of



their actions. It is the viewer's perspective that is interesting. What it might occasion when we are somewhere else. These differences in interaction are also reflected in the differences of the textile movements. As already mentioned, the first scenario is limited in intensity whereas the last scenario has increased intensity. The first does not change much in three dimensions whereas the last does, etc. It is also reflected in their positions. The first scenario has its value in its location and privacy. The last scenario is loud, placed outdoors in public.

We have been discussing scenarios from different perspectives. Some remarks are from an expression point of view, others from the interaction point of view, and some remarks relate to how expression and interaction are coupled together. In our own discussions with each other we saw the need to be able to describe certain differences between what each of us had seen so far. The textile expressions developed describe specific dynamic surface designs; they define basic textile expressions as a design language of movement that we used when designing the scenarios.

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