IS IT POSSIBLE
SWEDISH SCHOOL OF TEXTILES
Experimental Smart Textiles Design... it is a matter of

...exploring new design technology
This is the foundation of technology that defines the next generation of high-tech textiles materials and products. To explore and develop new means of expression; new expressional materials and construction techniques.
Carbon nano tube technology may open up for the development of conductive fibers, but what does it mean? If we turn this around and explore conductive fibers as a new expressional possibility in textile design we start with a different perspective where the issue of meaningfulness is fundamental for the questions we ask.

...exploring new design aesthetics
This is the foundation of expressiveness that defines the new products. To explore and develop new perspectives on textile expressions; new ways of understanding the basic logic of textile expression.
The textile sensor is not only a smart way to introduce soft and flexible sensors with use potential in many areas, it also a way to extend our understanding of textile expression. The notion of a textile surface will be different if we add sensing to expressional variables such as color and texture.

...exploring new design dimensions
This is what the big change in thinking about and using textiles is all about.
To explore and develop textile design as a design profession; to open up for new design variables by adding basic dimensions of expression.
We all know what a textile pattern is, don’t we? But assume that we open up for time as a new explicit design dimension, what does that mean in terms of textile patterns?

This is what makes programming and computational technology meaningful in textile design, rather than the other way around which is to view things in terms of technology driven development.

...exploring new design directions
This is where we are going.
To introduce and explore the visions that tell stories about where we are going; the way in which all these new textiles and textile expressions will change our way of working and living.
When technology changes and becomes textile in expression, interaction with technology will change and become different; soft and flexible properties of interaction will become a focal issue.

...displaying design technology
To critically review the foundations of the next generation of high-tech textiles materials and products.
Experimental design is important in the sense that it displays design technology; this is where the objects of design become a material thesis that opens up for discussion about technology.
Waiting for the future conductive fibers, we design with steel, copper etc to show what it is we think about.

...displaying design aesthetics
To critically review the new expressiveness.
Experimental design is important in the sense that it displays design aesthetics; this is where the objects of design become a material thesis that opens up for discussion about expressional matters.
We design the dynamic patterns to show what it is we think about.

...introducing new design programs
To define the new products.
We need to introduce and experimentally explore new design programs that sketch new areas of textile products as a way to bring change about.
Smart Textiles has initially been a rather technology driven area. Although there are attempts to introduce more general design programs as driving forces there are still much to do here. Mixing programs for sustainable design with ideas about smart textiles design would be interesting given the inherent tension in images between these both directions of textile design. The non-obvious here could helps us to deepen both perspectives.

... changing the design education
To change and redefine the textile design profession.
There is certainly a radical shift in education necessary to prepare for professional work within a changing profession. The ideas of textile materials, techniques, design expressions and design programs are changing and the issue of mastering basic means of expressions calls for a radical revision.
What does the textile designer have to know about new materials and techniques in order to master these materials and techniques as design materials and design techniques?
What does the textile designer have to know about programming in order to master the techniques introduced through new notions of textile patterns?
It is not enough to say that this calls for interdisciplinary cooperation. The designer has to master the basic means of expression at hand and for that we need to change education. But in what way?
CHROMATIC CHLOROPHYLL -
Conceptual Hospital Textiles with Chromatic Smart Materials

MARIE LEDENDAL

Chromatic Chlorophyll looks at how Smart Textiles can change today’s view and use in the interior textiles of the healthcare environment through two conceptual concepts where colour changes with photochromics and hermochromics works as an information bridge for partly isolated patients.

Research indicates that nature has a calming affect on patients; the base for the expression has therefore been flowers and leaves. The colour change creates a subtle communicative bridge between patient and movement in the hospital - the Rhythm of the House - as well patient and the outdoor lighting - the Rhythm of the Sun.

The conceptual proposal presents a design solution where the colour changeability stands for a communicative level, as well as a decorative and a dynamic level. The textile samples communicate the visual and haptic expression, as well as the integration of the electronics. The scenario is set to the 2015-20, due to reasonability for Smart Textiles to be fully developed to be used as interior textile products in the healthcare environment.

Techniques: Screen and digital printing, embroidery and extrusion of yarns

Colour changing materials: Photochromic threads as well as Photochromic and Thermochromic inks and dyes

Acknowledgement: Prof. Bob Christie and Ibrahim Waseem, Chemistry Ph.D. student, School of Textile/Heriot-Watt University/Scotland, Proteko Stiftelsen, Smart Textiles Initiative

Photographer/3D visualisation: Henrik Bengtsson, Marie Ledendal
Light Shell is an investigation into self lighting textile shells – textile spaces. A Light Shell aims to enrich its future architectural environment through lighting and being a sensual stimulation of everyday life which can be experienced through vision, touch and being open to move inside and around. It is an investigation into the relation between light emitting textile surfaces, the human body and space.

The words Light and Shell describe the core values of this project. They combine today’s society’s need for light and a space to adjourn to.

A Light Shell functions as an aesthetic, poetic shield for the body. It creates an internal space in an architectural frame where people can withdraw for a while. It is supposed to surround the body with an embosoming gesture to give the feeling of safety and well being. Being surrounded by a dynamically changing light supports a person with a regenerating and relaxing element. The exhibited prototypes represent one final design concept which visualizes how a Light Shell could feel like.

PMMA optical fibres have been the light emitting media in this project. From the perspective of light and its impact on the human body optical fibres are an ideal media to transmit daylight directly or light from an artificial light source. They allow to bring dynamic changing light into the architectural space.

PMMA optical fibres are from a design perspective interesting in a textile context as they are, in their appearance, quite close to transparent monofilament. It opens the possibility to integrate them as a normal thread in a textile structure. To create a self lighting textile surface, being textile and light source at the same time.

Technique: 3D knitting
Lighting Material: PMMA optical fibres
Acknowledgement: Lars Brandin, Knitting Department/ Swedish School of Textiles, Javier Ferreira Gonzalez, DAAD (German Academic Exchange Service), Proteko Stiftelsen, Smart Textiles Initiative
Photographer: Henrik Bengtsson, Barbara Jansen
Starting from the relation between light, textiles and space the present project proposes a vision of textiles as an interface between interior and exterior as part of building facades. The purpose of the project is to reintroduce textiles as an alternative to the functional and aesthetic layer of glass by being applied to the interior part of the façade. This is to create a textile interface that interacts with light between the indoor and outdoor environment; to offer architects an advanced textile complement to the conventional materials in building design.

The design process follows two general paths, one oriented towards function having as aim to enhance the functional potential of the material by material choice and production technique, and the other towards expression by using the emotional potential of the combination of textiles and light to enhance the user’s interaction with the built environment.

The result of the project consists in different prototype ideas that illustrate different possibilities to combine textiles with light in order to create an interactive environment. Each of the prototypes develops an individual idea based on the effect created by light and its surface. Alongside with the aesthetical values given by the exploration of the relation between textiles and light, the project has a strong technical approach by exploring different possibilities to integrate artificial light into the textile structures and to create three-dimensional surfaces using knitting as a technique.

The exhibited prototype Moonlighter is a light emitting knitted textile using florescent yarns together with electroluminescent wire as inlay. In day-time use the metal inside reflects the sun. In the night its pattern is interactive: the sound sensor is connected to the electroluminescent wire, lighting up more parts of the pattern as reacting to noise generated by the people passing by.

Technique: Flat knitting
Materials: electroluminescent wire, florescent yarn, sound sensor
Acknowledgement: Folke Sandvik, Knitting Department/Swedish School of Textiles
Photographer: Jan Berg, Delia Dumitrescu
A new design technique for irreversible textile patterns has been developed. This technique can be compared with commonly used burn-out techniques (Ausbrenner etc.), but without using chemicals.

Kanthal, a highly resistant heating wire, was knitted together with a blend of “conventional” textile yarns like cotton, wool, polyester and viscose into twelve different textile samples. In the samples, about five courses of heating wire were embroidered into parallel connections with a copper yarn. The textile samples were put on wooden frames and connected to a power supply. As the heating wires get hot, burned out patterns appear. The material combinations react to heat in different ways and the grade of expression varies in the samples. Some materials melt, others become dark/burned and some vanish or burn very quickly.

The burned out expression depends on a range of factors such as the textile construction, access to oxygen, yarn combinations, length and number of heating wires used for the parallel connections, power supply etc.

Being able to design a textile material by incorporating heat directly into the textile construction is considered as a new design technique for burned out patterns. By this technique, colour and structure changes in the material can be affected to create an aesthetic expression designing holes, stripes or cuts etc. The design technique enables a novel way of decorating a textile after a fabric is produced. It would be possible use this technique for showing information through colour- and structure changes in the textile using it as an ambient textile display.

Technique: knitting, embroidery
Materials: Kanthal, Kevlar, cotton, wool, polyester, viscose
Acknowledgment: Tommy Martinsson, Knitting Department/Swedish School of Textiles, IFP, Swerea, Smart Textiles through Vinnväxt
Photographer: Anna Persson
Imagine that the table is set and dinner is ready. It’s time to sit down and share the moment. That is what we do also in terms of sharing a one time pattern change in the tablecloth, and in terms of sharing each others’ mobile phone activity. Incoming phone calls and messages are not notified by the phones themselves, but through a burned out pattern in the tablecloth, in between our plates.

The Burning Tablecloth serves as a design example of the design technique for irreversible patterns, expressing colour and structure-changes in a knitted textile. The Burning Tablecloth changes colour and structure according to mobile phone signals (calls and text messages) with burned out patterns and acts as a medium for raising questions about interactive tactile and visual expressions in textiles. The project is a design example of research into three fields, knitted circuits, textile patterns and peoples’ relation to computational technology.

The tablecloth is knitted with cotton yarns and a heating wire in a Stoll flatbed knitting machine. The pattern that appears when using the tablecloth is built up as squares with the potential of becoming chess-patterned over the whole tablecloth surface. The tablecloth is connected to a microcontroller and various electronic components. The heating wire knitted in the tablecloth is the active material; when heated it is able to change the colour and structure of the tablecloth. The burning tablecloth reacts to mobile phone signals by getting warm so that colour and eventually structure changes is appearing in the tablecloth. The experiment demonstrates a design example where visual and tactile interactive properties are expressed in a tablecloth by mobile phone signals. Combined in a material structure, textile circuits are controlled by external stimuli adding an aesthetical value to the textile expression. With a foundation of experienced knowledge from latter experiments, the tablecloth shows an example developed by the design technique for irreversible patterns. The Burning Tablecloth also demonstrates how information can be expressed in an aesthetical way through textiles, acting as an interactive colour and structure changing ambient textile display.

Technique: Knitting, embroidery
Materials: Kanthal, cotton, basic X microcontroller, mobile phones, electronics
Acknowledgments: Folke Sandvik, Knitting Department/Swedish School of Textiles, IFP, Sverea, Smart Textiles through Vinnväxt
Photographer: Linda Worbin
This work deals with Smart Textiles in interaction with the body. We design textiles and outfits as tools that can influence fashion and textile design. Central to our work is that artistic envisioning can point to new possibilities and values, in which we want to stress the importance of combining traditional materials and methods with contemporary and future functions in order to obtain sustainable ideas.

The film documents a performance, where dancers create a link between the body, the textile material and the room surrounding the body. The textile material and the garment are to inspire movement that, in turn, creates development; when a person wears the garment and moves in a certain way or touches other persons, the visual expression of the room changes through an electronic signal. In this case, the colour of the pattern of the textile draping changes to the static pattern that is printed on the person’s outfit. The point of the show was to show possibilities of non-static and dynamic design through scenic expression. (Performance at Rydals Museum, spring 2008)

Technique: Costumes: knitting,
Wallhanging: Printing, weaving
Materials: Costumes: Cotton, silver thread, microcontroller Basic X, radiotranceiver, other electronics.
Wallhanging: Cotton, wool, steel, Thermochromic inks, microcontroller Basic X, radiotranceiver, other electronics

Acknowledgments: Lotta Lundstedt, Lars Hallnäs, Smart Textiles through Vinnväxt, Textil- och Modefabriken through Espira, Veerea Suvalo Grimberg and her dancers Daniella Strandberg and Thérese Olsson.

Photographer: Lars Hallnäs, Film: Lotta Lundstedt
TOUCHING LOOPS

DELIA DUMITRESCU
ANNA PERSSON

Touching Loops is a collection of three knitted textiles with structure-changing interactive properties. The textiles are able to sense and react to touch by shrinking, breaking or becoming stiff. The textiles are thought of as interactive architectural material. When they are touched, a specific area in the textile becomes hot. A microcontroller that is connected to the textile is programmed to sense and react to touch. The materials in the samples react to heat in different ways by shrinking, becoming stiff or by breaking into pieces.

The developing process consisted in programming the patterns for industrial machines in such a way that the conductive silver yarns are of important matter for the material aesthetics besides their function to generate heat. The three knitted pieces react in different ways when current passes through the conductive yarns. The first piece combines a silver coated copper yarn and Pemotex yarn in a ridge pattern. In the second sample a Jaquard pattern combines shrinking polyester monofilament, a Grilon yarn and a silver coated copper yarn. This piece reacts to heat by breaking and shrinking. The third piece is constructed with partial knitting and ridge patterns and the yarns used are Pemotex, a Grilon yarn and the silver coated copper yarn. When the conductive yarn gets hot, the ridges shrink and harden.

The aim of the project is to explore possibilities for expressive interactive tactile knitted materials and structures. The textiles are seen as a possible material to use in the context of architecture.

Technique: Flat knitting
Materials: Silver coated copper yarn, Pemotex, Grilon, shrinking polyester monofilament
Acknowledgement: Folke Sandvik, Knitting Department, Swedish School of Textiles, Vinnova Vinnväxt
Photographer/3D visualisation: Delia Dumitrescu
Aiming to open a new design space that connects three areas of architectural, interaction and textile design, the knitted structures *Furry lines* and *Groovy squares* were designed. By combining conventional textile yarns together with conductive yarns, the result investigates the sensation of warmth through the design of knitted structures. The purpose is to offer a synesthetic experience that correlate the physical and visual perception of space and focuses on tactility as an asset to create interactive architectural environments.

The structures were made using different knitting techniques, combining a silver-coated copper yarn and conventional textile yarns. The silver coated copper yarn is used both for heat generating and touch sensing properties. Connected to a microcontroller able to sense and react on small differences in electricity, the textile becomes a touch sensor itself. By offering feed-back to hand touch by becoming warmly pleasant to the skin, new types of patterns can be created using the combination between heat and human touch that exceed the visual dimension.

*Designing with heat* exemplifies how visible and invisible expressions merge into one experience, expressed through the textile material. The textile structure is perceived both through the eyes of imagination and the skin as heated patterns. The prototypes show how heat could be part of the surface aesthetics alongside with colour and shape.

**Technique:** Flat knitting  
**Materials:** Silver coated copper yarn, Pemotex, PA/Lycra, microcontroller Basic X  
**Acknowledgement:** Folke Sandvik, Knitting Department,/Swedish School of Textiles  
**Photographer:** Delia Dumitrescu
DELIA DUMITRESCU
BARBARA JANSEN
ANNA PERSSON
LINDA WORBIN

PHD Students,
The Swedish School of Textiles,
University of Borås,
Human-Technology-Design,
Chalmers University of Technology

HANNA LANDIN

PHD Student,
Human-Technology-Design,
Chalmers University of Technology

MARIE LEDENDAL

PHD Student,
School of Textiles and Design,
Heriot-Watt University, Scotland

AMY BONDESSON

Fashion Designer