Bijlage 2
Overview Electronic-Textiles
COS
A revolution in the textile industry is started. Original functions of textiles are replaced by synonyms with a better durability, comfort, protection and safety by electronics. E-textiles displays interactive behavior by imbedded electronics, such as sensors, actors, signal transmission and data processing.

Through the use of e-textiles the garment will offer an extra value to the customer in different levels as health-care controlling, protection, safety and entertainment. Thereby it makes the impact of the fashion industry on our world less.

This overview is created to see which e-textiles are suitable in a business as COS (Collection of Style). Most of the selected concepts are experiments or prototypes.

Even though the prototypes are still not meant for mass production and washing, they will give inspiration and demonstrate what is possible to create in the fashion industry with the integration of electronics.
Part of the final thesis
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Light is still an important source of inspiration for many artists today. Traditional textile design is combined with the interactive technology of light.

These textiles have a sensor and active light integrated in the textile. When the sensor perceives stimuli, for instance contact with the human body, it will respond by lighting up at certain points in the garment.

The daily life of customers can become easier with the use of light in garments. It can be used around neck to gather light, around chest area for reading, around hands area for spotlight to find something in darkness or for all kind of playful effects.
The starting point for this project was to investigate weaving in relation to materials, texture and light. Malin Boback gathered inspiration from the interaction between water and light and the phenomena that can occur when light hits a drop of water. The textiles are a series of experiments.

1 Droplet is one of the created textiles, it consists of a jacquard fabric with fiber optics in combination with a shrinking yarn. The fabric has many dimensions and partly hide the light inside the fabric. Through the shrinking yarn the fabric will shrinks when heated and create a three-dimensional appearance. The inspiration comes from raindrops forming a pattern on a smooth surface.

2 Flow is the other created fabric (see picture) and is a transparent fabric woven on a dobby. Optical fibers run along the fabric and form irregular points of light. By programming the light with an electronic platform, shifts the fiber optics in different shades of blue and it creates the illusion of movement in the fabric. The inspiration comes from water flowing down a window.

+ Inspiring light-emitting methods in different shades of blue
- Experimental stadion and an electronic platform integrated in the fabric
A prototype created to explore new interactions of emotion, motion and micro-electronics using as a reference the human body. The aim of the project is to encourage the user of the dress to control their respiration and to breath deeply. A respiration sensor is integrated into the dress to detect the breaths. The signals are detected by a microcontroller and used to transform the strength of in- and exhaling into a corresponding light pattern. The dress can make the daily-life of the consumer easier and safer.

The inspiration for the dress is an illusion of air bubbles and ice crystals and are visualized by a pearl shimmering ornamental screen print and an amorphous embroidery on the white silk fabric. The LED’s are reflecting as a pearl when they light up from the inside of the dress.

+ Consumer can control respiration and breath deeply, contribute body controlling
- LED lights, sensors and a micro controller integrated in the dress
The aim of the project is to explore expressiveness of snow and its properties through combining a woven fabric with light. The fragile, translucent, reflective and cold feeling of ice was the inspiration for the project.

The swatches are all hand-woven in which optical fibres, effect yarns and mono-filament yarns were combined to create a piece with the expression of coldness and fragile ice. The size of the fabric can be enlarged through a shaft weaving machine. The light-emitting fabric displays the expression of snow and its properties.

+ Inspiration for a light-emitting fabric
- Experimental stadion and light programming integrated
Movement in between is a project where the fabric is used as a container. A container of light. By integrating small mirrors between two layers of hand-woven textiles in combination with light-emitting cords may reflect, store and emit light.

It consists of two layers transparent plain-weave fabrics, between the bearings are mirrors sewn. The fabric is pleated vertically in rows of mirror pockets. Above the fabric is a three-dimensional pattern of circular knitted. To give a delicate impression and to reflect the light as much as possible, even in the textile parts, the room divider have a white color scheme.

The light moves by reflection, the pleated sections of the fabric shall mirrors to reflect in different directions and create a greater spread of light. The pattern is double in the reflecting mirrors and form a new pattern with a gap, because the mirrors are set apart from each other.

The fabric is now used as room divider, but is very interesting for accessories design.

+ Material can reflect, store and emit light
- Hard cords, elements and mirrors integrated in the fabric
The light-emitting paper is developed for a digital lighting prototype. It is part of an ongoing design work exploiting optical fibre technology within aesthetically-focused, light-emitting textiles.

The materials which used are a polymer-optical fibre, paper yarn, paper-based non-woven, white or RGB LED, battery or electrical source. The technique used are aligning fibre and yarn using warping stakes, laser etching and coupling optical fibres to a light source.

Traditional weaving techniques are combined with light-emitting properties of optical fibres and experiments with unconventional types of yarn, such as paper and enameled wire. The installation creates different colors and light effects and gives the appearance of movement. The fabric is as well interesting for the design of accessories.

+ The fabric is light-emitting, movable and it creates different colors and light effects
- LED’s and batteries integrated in the fabric and the need of an electrical source
Spacemotion is included for inspiration of the use of light; these textiles are used for a wall. It is a modular system of textile discs that have been embroidered with conductive yarn to generate sensory outputs including light, sound and scent across a custom made surface.

The different discs can be added, removed or re-configured to change the layout of the wall. There are opportunities for patterns provided through the system, but also sensory functions be added as new applications emerge, technologies and printed responsive surfaces are developed.

The wall creates an easily transformable and configurable system of appliances able to contain different functionalities within a networked array of soft, repetitive disks acting as smart power and information hubs.

+ Light, sound and scent can be added, it acts as information hubs and a whole experience
- Hard sensory discs and conductive yarns are used
A project created for an exploration into textiles and electronics. The product consists of a knitted variable resistor which changes the resistance while toying around with the front part of the hoodie. When the seams of the hoodie are touched the light intensity of the hoodie will change.

There is an electronic system under the hood of the interactive garment integrated. The knitted resistor is connected via a pull-up resistor to an analog-in pin of the electrical system.

A digital pin-out of the electrical system sends a modulation via a transistor to introduce the 12V source for the LED strip concealed in the seam of the hood.

+ The garment is playful, emotional, sensual and makes the daily life of the user easier

- The need of a 12V source and an integrated LED strip and electrical system

Skôn
by Paula Kassenaar
Tender is a garment that exhibits a structural knit textile that incorporates programmable microchips in each pocket integrated into the material. It can be programmed to react on different inputs, perform a range of actions and give desirable output. A touch sensitive garment is one of the many possible applications of the developed textile.

Tender is a garment that reacts to stroking. It lights up separate pockets on the body according to how they have been in contact with the skin. By stroking the garment it is possible to move the lighted part of the wearable. It can be used to gather light around the neck, chest area for reading, hands area for spotlight to find something in darkness or for all kind of playful results, effects.

Tender represents the value of the new craftsmanship. It is a combination of structural knitting, electronics and conceptual fur-bubble inspired look. It suggests the soft light and personalized interaction to be the luxury of today.

+ It makes the daily life of the user more comfortable, easy and playful
- The use of hard LED elements in the garment
Technical innovation is endless. With the use of electronics in textile design it is possible to let textiles change in shape by stimuli.

At the moment there are two different ways of changing the shape of a textile: shape memory and shape change through changing the appearance of the fabric. With shape memory the textile changes back in its original shape when you put power on it and the temperature changes.

Shape change is also possible to change the appearance of the fabric by changing the visual form. Scanning the fabric with an app and camera on a smartphone or tablet, will allow the user to see 3D objects rooted in the fabric. It shows interactive 3D objects appearing on a textile.

The longevity of textile products can be extended in the future by using the technique of changing in shape.

2 Textiles which change in shape
Textales is a project in the intersection of textile tradition and technological innovation. With Textales the storytelling through traditional textile and augmented reality fairy tale application is explored. Digital properties extend the textile capabilities and allow the long-lasting textile to change in time to remain interesting for the users. The developed stories demonstrate the possibilities of such storytelling. Textales is rooted in the research about craft values and sustainability. The aim for connecting digital dynamic properties with high quality textile is to extend the longevity of textile products through changing the idea of what textiles can do.

Textales show interactive 3D objects appearing on a woven textile. Scanning the cloth with the application will allow the user to see the flowers rooted in the fabric. By moving or manipulating the surface, the appearing objects move along.

The distinctive factor of Textales is the fact it is almost in bigger production and the fabric is washable.

+ A product for entertainment and it extend the longevity of garments
- Customer need a tablet for the function of storytelling

Textales by Kristi Kuusk
This knitting textile is an experiment, which is part of the e-textile summer camp program. The knitting textile is made of two layers of fabric that incorporate conductive threads. Each layer has a structure that alternates conductor strips and isolating strips that give the material the resilience to get back in shape after a pressure solicitation. The material consists of polyester yarns, copper threads and is coated with silver coating. A simple knitting technique is used.

“The greatest freedom of a designer is not to create new uses for a known fabric, but to invent a new fabric, and then to tackle its applications.” – Maurin Donneaud –

+ Fabric has the feature to get back in shape by itself
- In experimentalstadion and consists of conductive copper threads
Imagine an outfit which will warm you in the morning when you’re cycling, will ventilate you in the afternoon and will protect you from creasing, smelling and warmth on a party in the evening.

These textiles can all identify the touch of an human body, as a result, the integrated elements will activate the cooling or warming. It depends on the situation of the user. If the user is cool, it will heat up. If the user is warm, it will cool it. Anyways, in all textiles for temperature change is a sensor and actor integrated.

The garment will connect you with your body, it makes you more aware of touch, time and warmth.
From an energy efficiency perspective it is crazy that we all heat our complete houses and workspaces instead of just heating the microclimates around our bodies: the only place where you actually need warmth. Garments could function so well here by keeping your body at a comfortable temperature.

Incorporating carbon in conventional non-woven textiles makes them conductive with a high resistance, which makes them easily heat up by putting power on. By placing the non-woven at the spine, near some main blood flows, your total body feels comfortable warm by increasing the material temperature just one or two degrees.

Materials which used are lithium ion batteries, PCB, temperature sensor, polyester (72%), elastane (28%), ultra fine knit by Eurojersey, a polyester non woven and carbon and copper ribbon.

+ A realistic garment is able to keep the body of the customer warm
- Batteries and PCB integrated in the dress
A body cooling vest that can automatically detect a hot flush on the skin and responds by activating cooling elements integrated within the clothing. The garment will help women with the problem of hot flushes experienced by women going through the menopause. This resulted in a prototype for a special body-cooling vest.

The prototype contains a number of cooling elements, which are separated from the skin by a layer of fabric. It also features an integrated temperature sensor. During a hot flush, the skin temperature can rise by between 1 and 7 degrees, so it is quite easy to detect. The vest responds to the increase in temperature by activating the cooling elements. The cooling works at twenty-seconds intervals: 20 seconds of cooling, followed by 20 seconds pause, and so on. It is also possible to override the sensor. Women can deactivate the cooling effect themselves at the touch of a button. Just knowing that this is possible actually reduces the number of hot flushes women experience. This is because it partly reduces stress, which, combined with the fear of a hot flush, is a key factor in triggering another hot flush.

+ A realistic garment is able to cool the body of the user when body temperature increase
- Hard elements are touchable in the garment
Textiles which change in colour

The sensor in these textiles will detect a change in temperature in the environment, as a reaction, the textile will change in colour or transparency (black to white).

The colour change is possible through the use of thermochromic systems. The thermochromic textiles are used with electric heat- or cold profiling circuitry.

These colour change is also possible with thermochromic pigments or hydrochromatic paints, but these are more ‘smart textiles’ instead of ‘e-textiles’. There is no electronics integrated.

It creates a very close, intimate and unique connection between the user and the garment, because the garment will remain more exciting.
The project is selected for the overview with an inspirational reason, it's till now used as wall in the interior sector. It is a material research project that aims to develop resonsive materials for future ambient displays, which would make it possible to visualize electrical energy flows, consequently demanding the viewers’ attention and potentially generating their awareness of electricity use.

An electro reactive material whose graphics are changing colours when electricity is going through. This colour change is made possible though the use of an electro reactive material specially engineered for this project. Combining conductive and electro reactive technologies, this material turns the invisible into something tangible for the user. The project is interesting for accessoires design.

- The awareness of energy consumption and colour changing through graphics
- Use of hard, special electro reactive materials
Thermo Dance relates back to the initial property of textiles to fade off or change in color in time and while being exposed to the UV-light. In this project the process is speeded up, but the notion of tracking and being aware of time, remains. It explores playful color change in a textile worn by dancers.

The textile changes color depending on the ambient and body temperature. The integrated conductive threads allow also controlling the color change by applying electricity to the garment. Color change on the costume is very subtle and can be discovered only from a close distance. It allows the dancer to intimately interact with her body, and be inspired by the slight changes in the appearance of her dress.

Materials which used are thermochromic pigment 27C, cotton, wool and viscose yarns and a conductive yarn.

+ The notion of tracking and being aware of time through color change
- Applying electricity to the garment to control the color change
The created samples are part of the project of an investigation of the design potential of thermochromic textiles used with electronic heat-profiling circuitry.

The systems offered a lot of opportunities in their application to textiles, including the previously unexploited design potential of their ability to change through a spectrum of colours, facilitated further by access to some unique materials made available by the industrial collaboration. Each swatch will be slightly different as they are taken from development samples.

However, each swatch is touch sensitive, and will change through a series of colour changes up to and sometimes over 40 degrees. The used fabrics are laser etched, screen printed and coated cotton/satin.

+ Fabrics bring a spectrum of colors, unique pieces and each swatch is touch sensitive
- The need of thermochromic systems
Unlace is an interactive lace lingerie garment, which allows partners to connect by becoming more aware of touch, time and warmth. The man’s touch on the woman is sensed by the garment after which the surrounding threads slowly heat up and change from black to skin color, it is like undressing the woman and guiding the man’s hand to another spot of touch. The slow change of transparancy and warmth increases awareness of touch and creates time to explore the woman’s body together.

The old craft of bobbin lace making was the inspiration and technique used in this project. Based on the transparant property of lace the concept still holds the value of the traditional craft besides the technique. Bobbin lace making is used in a modern way by changing the scale and using smart materials, making it into something much more than just a decorative piece.

Materials which used are thermochromic ink, conductive yarn and satin cord.

+ Awareness of touch through slow change of transparancy and warmth
- Need of thermochromic ink and conductive yarns
Intimacy is a high-tech fashion project exploring the relation between intimacy and technology. Its high-tech garments are made out of opaque smart e-foils that become increasingly transparent based on close and personal encounters with people. Social interactions determine the garments’ level of transparency, creating a sensual play of disclosure.

Wearable dresses composed of leather and smart e-foils which are daringly perfect to wear on the red carpet. In response to the heartbeat of each person, the dress becomes more or less transparent. The body is revealed based on your interactions with the dress. In Intimacy upgraded e-foil transforms from black to transparent. The design enables the wearer to engage in a wholly super-natural experience with her own skin. The result is a futuristic gown which any stylish woman living in the 22nd century would want to wear to her party.

The e-fashion of Daan Roosegaarde works as a second skin that transforms the body of the wearer into an interface. The project consists of high-tech garments made with wireless, interactive technologies and smart foils that can become transparent when electrified. The distance between a spectator and the garments determines the garments’ level of transparency, creating an intimate experience and a sensual play of disclosure.

The project straddles the world of fashion, wearable technology and electronic arts.

+ Stylish dress for a party, the experience of intimation and a sensual play of disclosure
- The need of electricity to make it happen
Textiles which can vibrate

These textiles are until today mainly used in the healthcare sector for well-being. By touching the textiles, the vibrations can be felt by the user.

The consumer can feel, move and recover through vibration therapy or just vibration. There are electronic circuit boards embedded in the fabric that enable the garment to sense touch and vibrate specific pressure points on the body.

The fabrics are consequently used for medical reasons, but as well for entertaining reasons. Think about a coat which can massage your neck when you become stressed, it can help the user in the everyday life.
Vibe-ing is a self-care tool in the form of a garment, which invites the body to feel, move and heal through vibration therapy. The merino wool garment contains knitted pockets, embedded with electronic circuit boards that enable the garment to sense touch and vibrate specific pressure points on the body.

By integrating vibration actuators in textile pockets the design enabled programming the exact areas and the way of stimulation on the body depending on the specific person’s need for rehabilitation and healing. Using fully-fashioned manufacturing techniques makes possible to customize the garment to the preferences of an individual body.

The aim of this design was to inform about the opportunities of integrating textile and vibration for self-healthcare services at home or in everyday activities.

+ Feeling, moving and healing through vibration therapy
- Integrated electronic circuit boards and hard vibration actuators
Tactile dialogues is a textile object in the form of a pillow with integrated vibration elements that react to touch. The goal of the textile object is to enable a dialogue by triggering physical communication patterns between a person with severe dementia (care receiver) and a family-member or care taker (care giver). The object also responds to activity and hand movement, which is important for people with dementia. It can be used in spaces where two people are sitting, e.g. at a table.

The pillow consists of a textile with integrated vibration elements. When these elements are touched a soft vibration can be felt from multiple locations on the object. When both sides are touched the vibration will increase. This stimulates small movements and social connection between the people.

The used materials are cotton, wires, 3D printed casing, Bekinox yarns, vibration motors, a motor board and a battery.

+ Responds to touch and hands movement through vibration and creates connection
- The need of hard wires, motors, motor boards and batteries
According to fashion technologist Pauline van Dongen is wearable energy a sustainable answer to our increasing demand for energy and connectivity, while also anticipating the vastly expanding wearable technology market. Clothes for everyday wear that can charge your phone or other USB technologies.

However, fashionably using solar, wind and even kinetic energy to charge devices, keep us connected and even donate our energy to non-profits is being explored now by a number of fashion designers.

“If you look around you, textiles cover so many surfaces, so why not give them a ‘super power’ that can take advantage of this, like solar energy harvesting,” says Mag Grant from Solar Fiber.

The use of solar cells in clothes can make the consumers much more sustainable, but first the electronic components needs to become more flexible and durable.
The solar shirt is the most recent design in the wearable solar garments. The shirt seamlessly incorporates 120 thin film solar cells that are combined into standardized functional modules, using a stretchable technology for integrating electronics into fabrics. It combines solar panels and flexible electronics into an attractive T-shirt for everyday wear that can charge a smartphone or any other USB compatible, portable devices. Electricity can be stored for later use in the shirt’s battery pack, invisibly located in the front pocket.

The night blue T-shirt is made out of a double-knit with a subtle texture and shine. It has been ingeniously constructed out of one piece of fabric, resulting in a softly rounded loose fit shape, while at the same time allowing the solar modules to be laminated before constructing the garment. The design of the solar modules has been approached from an aesthetic perspective, making the circuitry an elegant and striking feature of the design.

With this attractive yet practical garment that people could wear every day, solar fashion comes from the catwalk to the high street.

+ Charge smartphone and all other USB devices in an elegant, flexible and stretchable design
- The use of hard solar panels
Solar dress
by Pauline van Dongen

Solar cells have been constructed to capture solar light and convert it into electricity. Their internal structure is layered and resembles the stratified cells of the human body, which naturally interacts with sunlight. If a body is augmented with solar cells it will embody enough electrical power to become a real source of energy.

For this project, a coat and a dress have been designed placing solar cells close to the body. The two wool and leather prototypes comprise parts with solar cells which can be revealed when the sun shines or folded away and worn invisibly when they aren’t directly needed. The coat incorporates 48 rigid solar cells while the dress 72 flexible solar cells. Each of them, if worn in the full sun for an hour, can store enough energy to allow a typical smartphone to be 50% charged.

The sun is the biggest source of energy on earth and now that fossil fuels are depleting, it’s time we come up with a sustainable alternative.

+ Solar cells can be revealed for embody electrical power and folded away when it’s not needful
- The hard solar cells are placed close to the body
The solar shawl is the latest project of the team called Solar Fiber, a team of scientists who are using renewable energy methods to produce fabrics which can eventually be used in the fashion industry. It is a prototype which displays the amount of energy being generated in real-time. The Dutch company Van den Acker helped the team with the realisation of the product.

The prototype is especially useful to get more information for later when the real photovoltaic yarn is ready for the commercial fashion industry. Not only is this phenomenon intriguing, but it is equally exciting as such developments could change the face of fashion and renewable energy in the future.

+ Displays the amount of energy and possibility for saving energy
- A shawl needs to be soft and smooth, not possible through the hard elements
Solar fiber dress
by Meg Grant

This dress is the last concept of one of the concepts of applying a hard solar technology to flexible textiles in creative and innovative ways that are opening the doors. This dress has also the feature to adopt solar energy and store these energy.

A special fiber optic is used to make the streps of the dress. Grant uses a polyester fabric that had a very large weave and removed some of the original threads in order to replace them with the fiber optics. It doesn’t really matter what the textile is, the way of weaving is most important. It is more efficient for harnessing solar energy when you use a weave that has more exposure to sunlight.

+ The recording of energy, storing the energy and charging phones or tablets
- The integration of hard elements on the shoulderpart
Textiles in this category are now particularly used in health-care sector or sport- and outdoor sector for monitoring the health of the user. Garments are perfect for monitoring as close to the skin.

In the near future, more and more sensors will be more and more used in garments. Not only in sport- and outdoor, but also in the everyday life, according to Matt Hymers from Adidas.

An ultra-thin guide wire is directly woven in the breathable base layer of the garment, so the operations of the user can be recorded. The guide wire is equipped with minuscule sensors that are scattered across the entire shirt, these will sent the data to a certain computer system as a tablet or phone.
The B.B. Suit showcases a new way of 3D knitting by embedding copper yarns for connecting Wifi and GPS technology inside. The suit was tested during SXSW, a music and technology festival in Austin in the USA. A model’s location was broadcasted on Google Maps and invited musicians to upload their tracks to a purpose-built website that uses the suit as a walking URL.

The prototype was a success and helped to curate an eclectic playlist, but more importantly, it demonstrated how truly wearable technology could lead to vastly different user experiences. The shape of the 3D knitted garment is defined by the graphics, and contains pockets with space in the fabric to store the chips needed for the GPS, Wifi and future options. The two layers of cotton hide, protect and route the copper cables between the components.

+ The possibility to connect with Wifi and GPS and upload data to the suit
- Thick materials, copper cables and hard components are used
This swatch is produced by textile designer Pauline Vierne through the technique of resistive knitting. The fabric shows two different sides: one with the resistive thread, another with 100% viscose threads. For house textiles a 100% polyester thread is used, because this is for stronger applications.

When stretched the resistive thread lets electric voltage pass on the fabric because electrical resistance is down. Such fabric can be used to detect a presence, like a seat that lights a room when you sit in, but it can also be used for clothes to measure breathing, running rhythm or many other things.

+ A double face which can detect a presence or measure data like breathing and running rhythm
- For measuring the user needs an analog input and resistor
Vigour is a knitted long sleeve shirt with integrated stretch sensors made of conductive yarns, which monitors the movements of the upper body. It’s a piece of wearable technology for geriatric patients that would enable the physiotherapist to gain more insight in the patient’s exercise and their progress.

The garment can be worn all day and thereby gather a lot of data. Next to this the garment can be worn when executing rehabilitation exercise and give feedback to the wearer by making sound or optionally also vibrate to encourage the wearer. The project has a high social value, since it advances ways of communication between Alzheimer patients and their therapists and encourages interaction and movement.

The materials used are wool, elastomeric adhesive, conductive yarns, custom elastic cabling and 3D printed casings.

+ The possibility to monitor the movements of the upper body of the user
- The use of conductive yarns and cabling
One of the latest innovations in sports data mining, the miCoach Elite System, represents the perfect combination of wearable technology and sports as it aims to change the way teams have trained in the past.

MiCoach Elite System consists of a small data cell that fits into a special pocket between the player’s shoulder blades. The jerseys are equipped with a series of sensors and GPS trackers that determine critical information like heart rate, distance, speed, power and acceleration. This data is then wirelessly transmitted to a central computer and sent to an iPad where coaches and trainers can analyze it. The information displayed on the iPad gives the coaching staff the ability to monitor, track, and compare the fitness and limitations of all the players. Which provides valuable insights about the amount of exertion players should experience during practices and games.

MiCoach is also simple to wear and does not restrict player movement. Although it does require players to wear an extra shirt which can be a tough sell on hot days. The distinctive factor of this concept is the fact that the shirt is producable and washable.

+ Health-care monitoring, data-mining, producable and washable
- The fit of the shirt need to be tight and close to the body
A large extent of the e-textiles contain conductive threads, otherwise the electronics doesn’t work.

These conductive textiles make you able to connect the fabric to an electronic circuit. They are used to make among other sensors and electronics functioning.

It is possible in a lot of shapes; there are for instance conductive threads, conductive coatings and conductive paints.

This category will show a number of ideas for conductive textiles which can only conduct, so the user always need a reactor and connector.
This sample is a digital sensor. The most striking thing about the swatch is the industrial process, because it is simple and possible to create in an industrial process.

It is a knitted sandwich idea where two conductive layers are separated by a raschel knit, insulative layer. Through pressure both sides will connect with each other. In the experimentation process there is also a diagonal instead of a horizontal hook-up used, so an analog interface is discovered.

+ A digital sensor which is simple and possible to create in an industrial process
- Sample can only conduct, so the user need a reactor
Conductive blackwork pattern
by Anja Hertenberger

The used materials for this sample consists of a conductive yarn, linen fabric and a cotton thread. The simple pattern of a blackwork embroidery is used for the pattern in the swatch, but only a part of the whole pattern to be able to create three conductive lines.

The edges of the sample are seamed with a cotton thread and a button hole stitch. The ends of the conductive threads are left and the other end of the embroidery lines are made in little loops, so the user is able to connect the sample to an electronic circuit.

+ The textile has the possibility to connect with an electronic circuit in a creative way
- Sample can only conduct, the user need an reactor
The swatch consists of a 100% cotton thread and a conductive thread. The technique of bobbin-lace making is used for the sample. Bobbin-lace making started in the 16th century in Italy. Back then the lace was made with gold and silver-wrapped threads or colored silk and linen threads to create rich and extravagant designs. Inspired by the historical lace making, this sample explores the possibilities of using this old technique today to create contemporary designs.

This sample is made using silver plated threads and cotton yarns. Additionally to pure visual pleasure this sample is functional for e-textiles use, e.g. for electrical circuits. The design can be developed and used as a conductor or as a sensor.

+ The function of a conductor or sensor in a textile
- Swatch can only conduct, so need a reactor and electrical circuit
This fabric is an experimental swatch, and has the function of a sensor. The used machine for this knit is a double bed linear knitting machine. The copper parts in the relief of the knit are created by using tuck stitches to obtain two conductive and isolated sides. When you press on one of the points where conductive threads cross, the electrical switch is closed and the electricity will flow.

Two different kinds of conductive threads are used: one highly conductive (made of copper) and one resistive specific (made of silver plated). Due to the sush resistive component we can get different, resistive values. Because of them it is possible to determine the position of the contact.

Furthermore, the sample can use six different pressure sensors areas. All six areas are connected to the analog inputs. They can be programmed together or individually according the chosen scenario.

+ The functions of a sensor, through pressure the electricity will flow
- Swatch can only conduct, so need a reactor and connection
The materials of the swatch are a conductive fabric, red termochromic ink and a conductive thread. The idea for the swatch is textile monitor or screen, so it is esthetic research. Each one of its fibers in the swatch have the ability to appear and disappear to create an animation. The original decorative function of the swatch is adapted. The structure of this textile is suited to carry metallic threads in its weft. These threads are completely isolated from one another.

This textile contains a lot of conductive fibers, it can obtain a very fine resolution. The electric principle is based on a simple short circuit that lasts for just a moment to heat up one thread which in turn activates the thermochromic pigment in the textile.

A conductive thread is sewn on the selfedge to connect every fibre to one pole of the electricity source. The second pole is made by a single thread that you should move on to the fabric to cause short circuits that animate the fabric. This sample represent a source of inspiration for future projects.

+ An inspirational for a conductive textile sensor

- Swatch can only conduct, so need of electricity source and reactor