INTERACTIVE TECHNOTEXTILES - THE HYBRID BETWEEN TEXTILES AND TECHNOLOGY

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Ultra Smart Textiles are the latest generation of Smart Textiles, which can sense, react and adopt themselves to environmental conditions or stimuli from mechanical, thermal, chemical, electrical or magnetic sources. Thus the participatory audience experience is significantly heightened, "pushing the boundaries", compared to models created with earlier technologies.

Introduction

Much has been discussed about Smart Fabrics lately. This rapidly growing field offers a huge range of research opportunities and new areas for investigations. These materials with incorporated technological elements enable the fabrics to transform into interactive interfaces. While numerous research opportunities as well as innovative method development by artists are offered in this field, it has to be noted that the goal of research is towards a pragmatic outcome closely linked to industry. The artist in this specific field serves as a conduit for knowledge transfer. A significant amount of astonishing results are already generated. Nevertheless several questions remain unanswered and need further explorations.

While basic research in this specific area has already been undertaken for more then ten years, recent developments present novel technical possibilities that are beginning to redefine textiles as a unique multidisciplinary field of innovation. Novel technology combined with one of the oldest traditions, the production of textiles, facilitates astonishing results on many different levels. Several papers already discussed applications of wearable's and fashion technology. To a lesser degree artists were looking into new possibilities of using Smart Textile materials as interactive surfaces by including these materials in site-specific installations. While Intelligent Textiles are nowadays still more connected with fashion or wearable's, health, sport or military use, there are huge possibilities for an artistic approach connected to site specific and interactive works. In the gadget or fashion field the technological tools are often separated from the textile material, yet unique developments for embedded technology inside the fabric are already being investigated offering new potentials. Observations show very clearly that a lot of research is still needed. How can these materials be used to create meaningful representations? How can the sensory aspect be further developed? How can the practical use of Smart Fabrics be widely promoted beyond the fashion and sports industry? This paper will focus on how the use of Intelligent Fabrics can be integrated more effectively in artworks that explore artistic and technical opportunities to enable new aesthetic perspectives.

The Hybrid Between Textiles and Technology

At the beginning I would like to introduce and define a few basic terms. The first generation, which could only sense the environmental conditions or stimulus, was called Passive Smart Textiles. The second generation, Active Smart Textiles, has both actuators and sensors. The actuators act upon the detected signal either directly or from a central control unit. Active Smart Textiles are shape memory,

chameleonic, water-resistant, vapor permeable and absorbing (hydrophilic/non porous), heat storage, thermo regulated and heat evolving materials. Ultra Smart Textiles are the latest generation, which can sense, react and adopt themselves to environmental conditions or stimuli. A very Intelligent Textile essentially consists of a unit that works like the brain with cognition, reasoning and activating capacities.

The production of Ultra Smart Textiles became reality as a result of a propitious coming together of traditional textiles and scientific disciplines such as the science of materials, structural mechanics, sensor technology, advanced detection-technology processes, communication artificial intelligence or biology. Integrating technology into textiles goes far beyond then just attaching electronics or devices underneath the surface. It has to be distinct whether the technology is attached or imbedded to the textiles.

Possible technical solutions for combining electronics with textiles are:

- Attached
- Embedded
- Woven into the textile
- Integrated into fibers

It can be observed that there is a tendency technology and electronics especially in the area of fashion design, performance and gadgets still quite often is separated or hidden under the surface of the textile material, where in other fields like for example in medical, sport or industrial textiles, remarkable developments take place in material science itself. While in early forms of wearable's sensors or gadgets were embedded between layers of textiles, stitched or crudely fed through seams, they where often described as interactive but needed the wearer to trigger various interfaces manually. Meanwhile embedded fibers can be equipped with cameras, microphones, speakers or sensors, which consequently leads to an improvement of interactive solutions and new possibilities for intelligent garments. Major research in this field was investigated lately at MIT, (Massachusetts Institute of Technology), for military use. Cameras or microphones embedded into textiles cannot only store information on computer circuits; they can also transmit and receive data by an external signal. [1] Today this technology first developed for the US military finds its way to subtle surveillance or sporting applications. Electronic modules are becoming rapidly smaller, lighter and more flexible, which consequently provides a better adoption to fibers and the soft tactile textile material. Attributes like "smarter", "reactive", "stronger", "faster", lighter", characterize these sleek fibers and materials. Remarkable developments are currently taking place in the improvement and engineering of fibers and material science, like for examples in the area of nanotechnology, sustainability, conductive fibers, glass fibers, luminescent textiles or woven interfaces.

Traditionally textiles used to be a "dead material", once manufactured they did not change the visual appearance of the surface anymore. As Piila Saksela [2] points out, " whatever material you are confronted with, it is already dead- the flax has been cut, the lamb shorn and silkworm has offered up its silk. All these diverse materials need new life breathed into them, they need be recreated in a new form."

Through the integration of various novel applications, materials like conductive fibers, electronic elements and PCMs (Phase Change Materials) fabrics develop the capability to communicate with their surrounding. Additional integrated sensory technology enables textiles interactive qualities. While PCM´s, some printing techniques or advanced coatings are rather applied on the textiles surface, there shows a clear tendency for new solutions which are already integrated in the weaving process.

Besides material science advancement, technical solutions cover the wide- ranging field of textile manufacturing applications. Digital Jacquard looms can translate digital data into woven surfaces. Ink-jet printing machines are able to transform digital information to large-scale formats printed on fabrics. Other digital machines allow for the developing of new processes for knitting and embroidery. Converting technically or chemically enriched fibers into intelligent materials combined with improved manufacturing applications push artists' and designers' ideas and their projects far beyond a traditionally use of textiles.

Developing an intelligent fabric mostly requires a team of professionals like textile engineers, researchers and technicians. Without support from a professional lab or institute it is nearly impossible to develop an Ultra Smart Textile. The artist's position moves towards the intersection between textile research, material science, the production of ideas and content, design, industry and the art scene. A critical analysis of electrically enriched textiles shows clearly the complexity of the improvement of Intelligent Textiles. This might also be one of the reasons why these kinds of materials are still nowadays rather rarely used in artistic installations. A much wider field of application is linked towards industrial products. Textile companies realized that there is a big potential to collaborate with artists in the readjustment process of developing experimental applications for intelligent materials. Leading textile companies on the European market are aware that the production of Smart Textiles can help them to strengthen there position on the market compared to low prize productions from the Asian market. Still many investigations in this area are rather prototypes then commercial interesting products. Nevertheless, companies are in the need to create unique and outstanding products and that's the fusion link to "unnecessary research". A playful and highly experimental approach of artistic projects can close the gap between a strictly commercial thinking and spectacular ideas and novel investigations.

Interactive Intelligent Textiles in Contemporary Art

It can be observed that an increasing amount of artists are integrating textiles in their art-works of late. While textile art frequently was coated with attributes like handicraft or decorative art, electronically enhanced or interactive intelligent fabrics generate fresh contents and aesthetics.

- Where are difficulties and challenges using Intelligent Textiles?
- What are the limitations?
- How can fibers react more interactively?
- What are future parameters of developments in this area?

While seeking for answers to these and other related questions, I would like to introduce some examples of already developed projects in the following, keeping in mind it is outside the scope of this paper to discuss various projects in detail, consequently only a few examples will be mentioned:

The engagement and interaction with the viewer can take place on several levels. Equally multifaceted are the directions of applications which can range from physical bodily engagement, motion responsive environment to emotional sensing and sound till via environmental data transfer or visualization.

Zane Berzina, [3] an artist and researcher born in Lativa and based in London, created in her project called "E-static Shadows", an artistic translation of electrostatics that manifests the potential of harvesting energy from immediate surroundings. In this technically highly advanced two-year research project she collaborated with an international team of electrical engineers and material scientists to link new

technologies and smart materials with more traditional textiles approaches. Berzina explains, “that the electronic textile acts as a static mirror responding to the usually invisible charges generated by people interacting with materials and making them visible. Equipped with LED lights, transistors and woven electronic circuits seamlessly integrated into the electronic structure, the installation is able to create transient shadows on the textile display in areas which detect a presence of electrostatic fields feeding on the changes created by viewers and objects.” In addition, Berzina points out, “This installation simultaneously acts as a simple sonic instrument in response to the presence and intensity of charges and human proximity”.

The Slow Furl Project, [4] a collaboration between Mette Ramsgard Thomsen and Karin Bech of the Center for Interactive Technology and Architecture in Copenhagen and the University of Brighton, combines textile technology with the emerging field of robotics. For this large-scale installation a custom-made soft textile skin was woven with conductive copper fibers. Robotic textile membranes function as sensory materials that can be programmed to interact with the potential for movement. This installation creates a playful environment interacting in slow motion with the viewers once entering the space. A mechanical system triggered through the touch of two parts of fabrics, initiate the change of the structures surface and shape. This project aims to explore the notion of flow.

Ligorano/Reese Collaboration [5] have been perfecting during the past years a new media work they call *“Fiber Optic Tapestry”.* In their description, “future tapestries will take the form of woven maps to show the appearance and disappearance of information from around the world; woven portraits, and use the individual´s Internet reading and self-metrics to create a picture of them; and a disaster tapestry that overloads and ultimately fails”. This textile-real-time animation is an abstract data visualization that continually updates as data changes. Information from Twitter and other data sources display color, light and pattern onto woven fiber optic panels using RGB LEDs. The computer controlled custom-made lightening system displays information on the fiber optic panels, which are woven on a handloom. These textiles created with contemporary communication materials and processes redefine the role of a tapestry. Ligorano and Reese explain, “In European culture medieval tapestries tell narratives and in the 21st century we find our stories threaded and networked throughout the web. The Fiber Optic Tapestry is an art form about networking, communication and society. It is like weaving information.”

The TITV Greiz, a German based Institute for Special Textiles and Flexible Materials is one of Europe’s leading textile research centers. Two of their current research projects are based on the integration of LED technology into textiles. The “TexoLED Project” [6] investigates the integration of stiff OLEDs in spacer warp knitting. OLEDs are organic light emitting diodes in which the emissive electroluminescent layer is a film of organic compounds, which emit light responses to an electric current. The advantage of this technology is the combination of organic LEDs with electronic circuits made of synthetic materials that create fully flexible displays that are almost able to arbitrarily bend, fold or curl. The aim of this method is ether to print electric circuits on the back of the fabric or implement conductive threads in the weaving process. However, this process can turn fabrics into flexible displays.

From Fiber Art to Intelligent Textiles

What is commonly known as fiber art has a longstanding background in the history of art. In the late 1950´s and early 1960´s a new generation of artists started experimenting with a variety of new aesthetics combined with old textile techniques. One of the first mentioned electronically enhanced garments

as artistic expression dates back to 1956. The Japanese artist Atsuko Tanaka [7] created for her performances the “Electronic Dress”. Flashing multicolored lights were embedded in textile. Many developments in this area have happened ever since then. Today numerous Intelligent Textiles are developed with integrated light sources like LEDs, luminescent fibers, light-wires or light-emitting fabrics woven with optic fiber.

Profitable applications might ask for different standards then artistic applications of intelligent textiles. But exactly through this synergy spectacular ideas might appear. They can be at the first glace useless for commercial interests, maybe even inefficient or just simple humorous, play-and joyful, but can turn out as the base for adopted further developments or generate new products.

In industrial production technical solutions need to fulfill certain requirements or standards, mostly in terms of international norms or production conditions. Contrary to the normal practices of industrial protocol, artistic projects do have much higher levels of freedom to experiment or create very unique and playful solutions specifically developed for a certain artwork. Nevertheless there are several companies or institutions that collaborate with artists and invest a huge amount of their budget for the research in these new areas. One of them is Philips Design Probes. [8] The program of this private research organization based in the Netherlands is dedicated to “far-future” research of combining textiles and wearable’s with sensory intelligence. Sheer limitless applications of digital technology explore, extend and enhance the human body´s ability to sense. Though their program is rather connected with commercial interests, nevertheless novel investigations in terms of sensory intelligence are explored in this research center.

Textiles and Interactivity

Textiles provide certain qualities no other materials can offer. When it comes to design there are nearly no restrictions in terms of shape, size and scale. They easily can become an integrated part of the environment and can be applied in two or three dimensionality. An enormous flexibility characterizes this material. When working with layers, surfaces can interact and create more complex compositions with depth of field. They are light in weight and predestined for mobility and easy to transport. The play between color, brightness and matte-ness, surface, line and the texture of the threads enable a unique creation of structures and surfaces. A haptic or sensuousness appearance of textiles often evokes the desire of touch and feel. Consequently these attributes allow playful applications combined with interactive or smart solutions.

New frontiers of perception and interaction are created by current technology. The comprehensive spectrum of innovative spatial and interactive work reveals how technology is fundamentally changing the use of textiles in artistic projects. Touch, engagement, exploration and intervention are just a few attributes that describe main sources of inspiration characterizing interactive applications for intelligent textiles. Artists and media designers are increasingly creating objects that communicate and installations are brought to life with the help of responsive low-and high-tech technology. Compared to models created with earlier technologies the question arises how specifically the use of intelligent textiles can be more effectively integrated in interactive or site-specific artworks.

- How can the participatory audience’s experience be significantly heightened?
- How can the support of artistic projects push the development of Smart Textiles further?

Conclusion

The enormous complexity of many of the multidisciplinary research projects in this area involves mostly a whole range of specialists and experts with varying backgrounds. Without proper funding or the support of institutions, labs or industrial companies, it still remains difficult for the individual artist to work in this field. However, it can be observed that already a whole range of exciting projects was recently realized. Critical analysis illustrate clearly that it has to be distinguished between a commercial use of intelligent textiles and an artistic approach. Nevertheless in this specific field, a multidisciplinary collaboration of various disciplines may prove indispensable. It has to be noted that the goal of research is towards a pragmatic outcome closely linked to industry. The artist in this specific field serves as a conduit for knowledge transfer. Artistic projects with intelligent fabrics do have the potential to push new investigations in this field far beyond there conventional limits.

References and Notes:

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