Advances in Science and Technology Vol. 80 (2013) pp 112-117
Online available since 2012/Sep/11 at www.scientific.net

doi:10.4028/www.scientific.net/AST.80.112

Research through design: a way to drive innovative solutions in the field of smart textiles

Marina Toeters[1,a], Martijn ten Bhömer[2,b], Eliza Bottenberg[1,c], Oscar Tomico[2,d], Ger Brinks[1,e]

[1]Saxion University of applied science Enschede (Saxion), The Netherlands
[2]Technical University Eindhoven (TU/e), The Netherlands

[a]m.j.toeters@saxion.nl, [b]m.t.bhomer@tue.nl, [c]e.bottenberg@saxion.nl, [d]o.tomico@tue.nl
[e]g.j.brinks@saxion.nl,

Keywords: Product Service Systems, Co-creation, Open Innovation, Designerly Approach, Smart Textiles, Research through design, Fabrication laboratory (Fablab), design for wellbeing

Abstract. Research through design allows creating a dialogue with the material. It uses making and reflection on action as a generator of knowledge. Our aim is to explore the opportunities and challenges of smart textiles. The Fablab is our set up, a place that allows us to combine the hacking-scientific-, and design community. It stimulates collaboration and the knowledge exchange needed for the development of smart textile systems. A collaborative prototyping workshop for medical products combined two worlds. The textile world in Saxion aims at incorporating conductive materials into textile structures and functional- / 3D printing to create systems for applications such as flexible heating systems and wearable technology. We combined this with the world of Industrial Design at TU/e, focused on the design of intelligent products, systems and services by the research through design approach. The collaboration between these different disciplines accelerated the process by reducing the resistance to the new and skipped the frustration on failure.

Introduction

There are many interesting smart textile concepts, however there are less relevant examples of concepts that are producible and valuable for our society. The so-called 'killer application' has not been found yet. That is why it is extremely important that multi-disciplinary parties team-up during the ideation process to come up with innovative solutions [1]. While in 1950 the Dutch textile industry accounted for 20 percent of manufacturing value added, in 2002 this has decreased to 2.3 percent [2]. This trend is progressing with the bulk of textile production industry relocating to low-wage countries. The production companies that remained in the Netherlands are struggling to stay profitable, for example by changing their business models towards more high value added products and creating a body of knowledge of advanced technical knowledge. Competition, high technological knowhow and a culture of cost-focused SME companies, make it difficult for this industry to collaborate and combine their strength. Although there are signs that this is changing considering the joint effort of the industry to join forces in the execution of the MODINT innovation roadmap program [3] and the establishment of OICAM.

The combination of soft materials and high technology is the area of smart textiles. Smart Textile Services (STS) are value propositions in which the smart textiles are part of larger services in which profit is not only based on the sales of physical products. STS require a network of different partners, not only textile partners, but also technology partners and service providers to collaborate in an open environment. This type of innovation network is also referred to as open-innovation [4]. Within the framework of the Dutch Creative Industry Scientific Program [5] we are creating an open-innovation network that will support the development of innovative Smart Textile Services. The goal of STS CRISP is to integrate existing knowledge from partners in the separate domains of textile (soft materials), technology and service providers.

To investigate the knowledge exchange necessary for the development of Smart Textile Services we organized a collaborative making workshop in which students from Saxion University of Applied Sciences and Eindhoven University of Technology (TU/e) participated. We will show the

results of three projects, the prototypes that were created during the workshop and the reflections of the participants on the workshops in relation to the collaboration process needed to develop Smart Textile Services. Finally, we will discuss how the STS CRISP consortium and the textile industry can benefit from this knowledge.

Method

We organized a collaborative making workshop in Fablab Enschede where we introduced the research through design approach to Saxion and TU/e students. The design goal of the participants was to develop new Smart Textile Services concepts for elderly that can be used during rehabilitation.

Multi-disciplinary collaboration. The Industrial Design department of TU/e and the Technical Commercial Textiles department of Saxion are both involved in the CRISP consortium. TU/e works with a self directed learning approach where a set of competences leads students from awareness of their profession towards in depth skills to develop themselves as visionary designers [6]. TU/e students have experience in the design of intelligent products, systems and related services by applying the research-through-design approach. The students in this workshop specialized in the Wearable Senses theme, where interaction with or between human bodies via textiles as medium is an important topic. The teaching principle in Saxion is based on the 'roof tile' method; first students get a theoretical base on a specific topic, then they apply their knowledge in projects [7]. The Saxion students study the topic of textile engineering and management during the first two years of their study, and later specialize in the topic of textile development. Saxion students are offered a fixed package of skills. The students who participated in the workshop are following a project with as goal to intensify the confrontation with the professional practice [8]. Saxion students have experience in textile techniques such as, conductive polymer yarns, functional inkjet- and 3D printing to create conductive systems, flexible heating systems and wearable technology products.

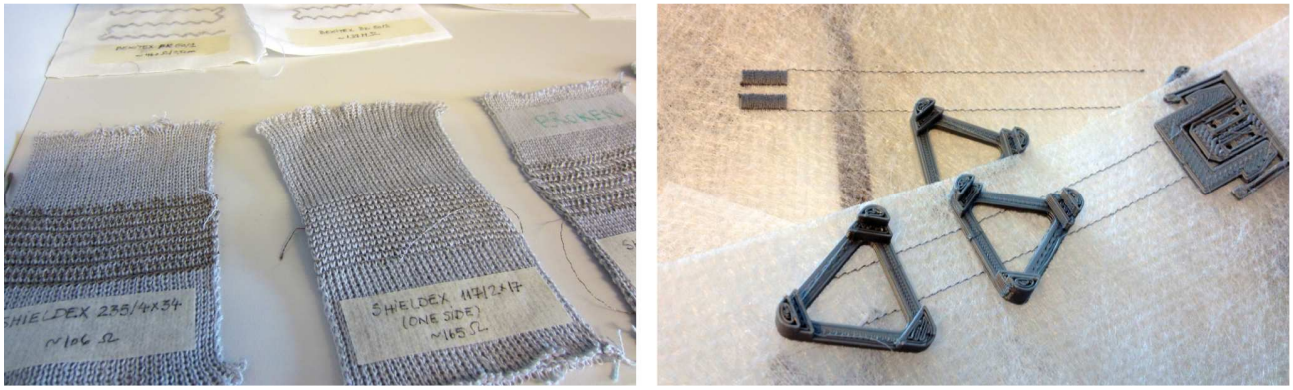

Figure 1: Examples of conductive yarns and 3D printed structures.

Research through design. The act of designing is not only a thought, but also a generator of knowledge. Creating tangible solutions that can be experienced are essential throughout the design process to validate ideas and to guide further developments. Moreover, "Design-making opens up new solution spaces that go beyond imagination, especially in group settings and when focusing on innovative, disruptive products which lack a well-established frame of reference for users or the market." [9]. By offering an inspiring setting, tools and materials we motivated all participants to create their ideas immediately. Students presented their initial prototypes, experts and students reflected together, new goals were set and finally new prototypes were created.

Location. The workshop took place in the Fablab in Enschede, described by its coordinator Wout Zweers as: "an approachable, public, digitally driven workspace where everybody can participate in the development of his or her own products". We choose for this location because collaboration requires a place to co-operate, in which we can take advantage of digital and physical space and exchange ideas, knowledge, and test design with potential users [9]. Further, the Fablab

setting allowed us to combine the hacking community, scientific community and design community and stimulate collaboration and the knowledge exchange needed to stimulate the development of smart textile products and services.

Design direction. To dive in a subject, create depth and move projects forward it is important to define, structure and frame assignments and goals beforehand. A common goal leads to a feeling of shared ownership, which makes collaboration and ideation easier [10]. With a selection of STS CRISP partners we decided to focus on the challenges and opportunities of an ageing society. More specifically, the partners agreed to design smart textile applications and services for elderly and other stakeholders in this design space during a rehabilitation process.

Results

Result 1. Ardjoen Mangre developed a flexible strap with integrated vibration for people with Parkinson Disease to keep walking and prevent freezing-up. The product will give rhythmic vibrations to the patient that simulates a walking rhythm. This enables the patient to maintain a comfortable walking pattern. Used technology: The frequency of the rhythmic cue is adjusted by a self-learning system to the speed that is comfortable for the patient. A LilyPad Arduino [11], (an accelerometer, conductive yarn, 2 tiny vibrators and a battery. All hand stitching.

Result 2. Pia Maria-Laux and Martijn ten Bhömer developed a knitted fabric that can measure stretch of the fabric. In this fabric the sensor would be directly integrated, enabling the fabric to be used in regular textile garments. For example to measure body movement when integrated in

garments used during rehabilitation exercises. Used technology: knitting stitches and conductive yarns (BK NM 50/2) to test the efficiency of the fabric. Can be linked directly to the electronics like Lilypad [11].

Result 3. Melissa Wagner, Franca Schneider developed an exercise-glove that helps people with hand-arthritis, a painful inflammation and stiffness of the joints. A stand-alone glove that conducts movement to train the fingers. Because of requirements such as user friendliness and design they created a stand-alone glove that guides movement to train the fingers. Used technology: First, inflatables and blowing themselves. Second, air-muscles and a little pump to inflate them. Third: a compressor to inflate the air-muscles. All machine stitched.

Reflections

During the workshop multiple prototypes were created, by applying an iterative research through design approach. Saxion student Melissa reflected: "I realize that you get most results by trial and error. If one prototype doesn't work out the way you expected, you can easily come up with another idea." Workshop organizer Martijn ten Bhömer noticed “students who were familiar with research through design found it easier to approach complex design challenges”. By making the prototypes the students simultaneously discovered how to approach the problem at hand, which in some situations can more effective than first drafting the system on paper. “Touching materials and demonstrators are important during collaboration, but also to talk to the clients and to convince the people in the boardroom” according to Martin Olde Weghuis, managing director of the Open Innovation Centre Advanced Materials (OICAM) [12].

Both reflections show the value of creating physical prototypes: as an approach to generate knowledge in the design process and as communication tool to convince other stakeholders.

Wout Zweers of Fablab Enschede reacted on the multi-disciplinarily collaboration during this workshop: “the difference was that TU/e students seemed to have a conceptual approach but were very clear on their target. Saxion students had a more explorative approach and performed more theoretical research.” TU/e student Ardjoen was aiming to give Parkinson patients the possibility to walk naturally. By having more theoretical support and knowledge from the Saxion experts about conductive yarns, he was able to choose the yarn with the right resistance for the application. Textile technology expert Eliza Bottenberg reacted that “the education methods of the TU/e and Saxion institutes already show a difference in approach. Whilst the Saxion students receive a learning approach that is hardly flexible with a clear aim on technical knowledge, the TU/e students learn how to develop a visionary mind and deepen their existing skills instead of their knowledge of technical subjects.”

Conclusion

The availability of materials, expertise and facilities from the Fablab, and the combination of expertise and skills from the students of both institutions drove the development of innovative smart textiles for eldercare and rehabilitation. The two organizing parties from TU/e and Saxion recognize the value in the collaboration between disciplines.
This accelerated the process by reducing the resistance to the new, and also skipped the frustration on failure. Research through design allows for creating a dialogue with the material and can lead to new innovative solutions. The trial and error design process that is enabled by rapid prototyping underlines the importance of open innovation environments such as the Fablab and OICAM.

These environments further enhance the collaboration between students, companies and designers. However, OICAM experiences in their daily practice that it can be difficult to get companies who are not familiar with open innovation on board [12]. Partners have to be convinced that open collaboration is valuable on beforehand.

For the STS CRISP consortium this means also that efforts have to be made to get new partners in the open-innovation network. As next steps we will continue to explore this concept of collaborative making workshops, combined with research through design approach.

Acknowledgements

This work is being carried out as part of the project “Smart Textile Services” sponsored by the Dutch Ministry of Economic Affairs under the CRISP program. We like to thank all the STS CRISP partners for their comments, special thanks to Unit040 for reflection on the student work. The workshop was kindly hosted by Saxion, Dr. P. Agrawal for the lecture about functional printing, Wout Zweers for introducing the Fablab, instructing the students and reflecting on the process afterwards. Harry Sanderink for the Sctats4Arduino workshop, Dyo Opstal for the knitting workshop, and students from Saxion and TU/e for their enthusiasm to participate in the project and the workshop.

References

[1] M.J. Toeters, Collaboration in fashion & technology. Retrieved May 31, 2012, from http://www.by-wire.net.

[2] M. Scheffer, (in press). Growth Regimes and Innovation in the Current Decade. In R. Shishoo (Ed.), The Global Textile and Clothing Industry, Woodhead publishing, to be issued September 2012.

[3] J. Wintermans, F. van den Berg, G. van Hooijdonk, A. Luiken, G.J. Brinks H. op den Brouw, Plan van aanpak Routekaart Textiel, (2011) Retrieved May 31, 2012, from http://www.modint.nl/branches/textielindustrie

[4] H. Chesbrough, Open Innovation: The New Imperative for Creating and Profiting from Technology. Boston: Harvard Business School Press. (2003)

[5] CRISP. CRISP | Creative Industry Scientific Programme. Retrieved May 31, 2012, from http://www.crisppplatform.nl. (2011)

[6] C. C. M. Hummels, & J. W. Frens, Designing for the unknown : A design process for the future generation of highly interactive systems and products. Proceedings of the 10th International Conference on Engineering and Product Design Education (Vol. 4, pp. 204-210). Barcelona, Spain. (2008).

[7] E. Engelen, private communication. May 2012.

[8] D. de Bie, J. de Kleijn. Wat gaan we doen? Het construeren en beoordelen van opdracht, Bohn Stafleu Van Loghum, Houden/Diegem, (2001)

[9] B. van Abel, R. Klaassen, L. Evers, & P. Troxler, (Eds.). Open Design Now: Why Design Cannot Remain Exclusive, Amsterdam, The Netherlands: BIS Publishers. (2011)

[10] M. ten Bhömer, O. Tomico, M.S. Kleinsmann, K. Kuusk, S. A. G. Wensveen, Designing Smart Textile Services through value networks, team mental models and shared ownership. Proceedings of ServDes '12. Espoo, Finland. (2012)

[11] L. Buechley, L., M. Eisenberg, The LilyPad Arduino: using computational textiles to investigate engagement, aesthetics, and diversity in computer science education, in Proceedings of the twenty-sixth annual SIGCHI conference on Human factors in computing systems Pages 423-432 , ACM New York, NY, USA (2008)

[12] M. Olde Weghuis, private communication. May 2012.

Smart and Interactive Textiles
10.4028/www.scientific.net/AST.80

Research through Design: A Way to Drive Innovative Solutions in the Field of Smart Textiles
10.4028/www.scientific.net/AST.80.112