Crafting Tools for Textile Electronic Making

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CHI'17 Extended Abstracts, May 06-11, 2017, Denver, CO, USA
ACM 978-1-4503-4656-6/17/05.
http://dx.doi.org/10.1145/3027063.3052972.

Abstract
This abstract introduces a set of tools for electronic textile crafts. The goal is to combine established textile craft routines with electronic functionalities while avoiding being limited to either crafting or engineering qualities. A discipline's toolset is decisive in what material can be handled and what output can be produced as well as the skills needed to handle it. New tools presented here allow for new interactions with materials and make new routines accessible to the processes of electronic making and textile crafting, potentially being inclusive to new user groups in the respective fields. Here, traditional needlecraft tools are adapted to integrate electric engineering needs. Functionally, these tools augment processes of textile crafting with information about electric properties of the artifact in production. More broadly, they are a chance to reflect on the roles and cultural assumptions of the technologies, and indeed crafts, that these tools enable.

Author Keywords
Electronics; crafts; tools; textiles; making culture; design.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

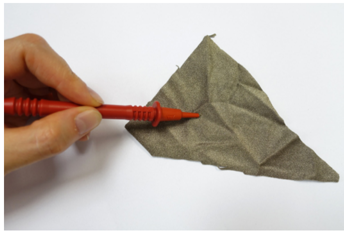

Figure 2 Contacting to fabric material with a standard multimeter test lead.

Figure 3 Comparing connecting to fabric with standard crocodile clips and custom made pin probes.

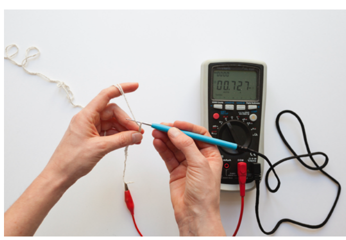

Figure 4 Using a connectable crochet hook to crochet a textile stretch sensor.

Introduction

Tools are essential instruments of access to any discipline and making routine. Their form and function shape what materials can be used and what objects are producible, both on a practical level as well as how they contextualize the making routines. The development and research of the Arduino Lilypad, for example, has demonstrated how the visual framing and functional adaptations contributed to making computational creation accessible to a different user group, enabling diverse outputs 2. Furthering this approach, (needle-) craft tools that allow direct integration with electronic engineering routines have been designed. They aim at supporting the integration of textile materials and skills to the field of electronic and computational making, potentially allowing for novel interactions, new user groups, and diverse creations.

A Crafting Approach to Making

Craft processes are distinguished by their procedural approach to the coming into being of an object. David Pye calls this the workmanship of risk, 'using any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on the judgment, dexterity, and care which the maker exercises as he works' 8. The popular term 'making' is less perceived as craft process, than broadly defined as a DIY process incorporating electronic or computational technologies. Opponents critique the focus on a new output, often neglecting the process that brings it into being, as well as the narrow perception of what is considered 'making' and thus relevant within the widely propagated 'Maker Culture' 5. The field of electronic textiles or e-textiles is one example how traditional craft routines and modern electronics can blend. Metal threads and metal-coated fabrics are used to create connections, sensors, interfaces or even active electronic components 3,6,7. They increasingly appear in soft interfaces or wearable applications as well as in educational settings. Craft techniques are used to form and connect the conductive textile materials; in a separate step electronic qualities of the work are evaluated with suitable measurement tools.

Textile crafts are century old technologies relying on well-established routines to fabricate with fibers and threads. The quality is predominantly defined through visual and tactile assessment of the resulting artifact. Electric elements, on the other hand, need to fulfill intangible qualities, for example being electrically conductive, to be considered functional. Designing new tools that allow for the combination of these distinct qualities could potentially render the creation of electronic objects into carefully executed and reflected crafting routines. Ideally, they integrate the manual routines with the intangible information about the electric properties of the creation without limitations to craft or engineering qualities.

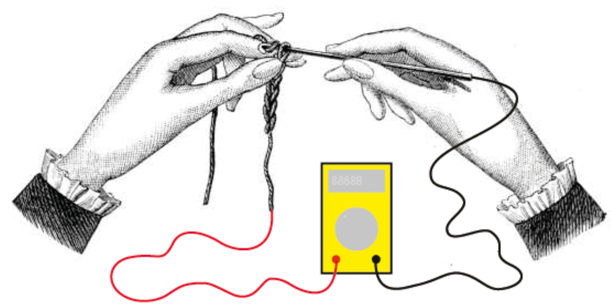

Figure 1 Collage combining traditional crochet techniques 4 with the information about its electric properties directly displayed on the multimeter.

Figure 5 A multimeter with custom test leads. The red cord has a pin at the end, the black cord connects to needlecaft tools.

Figure 6 Connectable needlecraft tools: an awl, a crochet hook, and a seam ripper.

Making Tools

Established textile tools served as an inspiration for the design of the tools introduced here. Their refined shapes have developed over centuries, allowing for good yet gentle contact with delicate fibers to form desired patterns. To measure electric properties of components or connections, test leads are needed to contact between the device under test and the measuring device. Combining these prerequisites, conventional needlecraft tools were made electrically connectable, to simultaneously serve as a tool for manipulation and testing of the material.

The initial tool set comprises standard, widely used needlecraft tools such as a seam ripper and a crochet hook. Their tips, having different shapes for different operations on threads and fabrics, are usually made out of metal. As such, they are conductive and can serve as the testing tip as well. To connect the tip with the measuring tool, a multimeter, for example, a custom handle for the tool is 3D printed. A wire leads from the tip through a hole in the handle to a mini banana plug at the other end of the tool. There, a cable can be plugged to connect the tool to the multimeter. Consequently, the seam ripper, or crochet hook, can be used as an individual textile tool, or when connected, as a test lead to measure electric properties. The craft tools preserve their traditional shape and function but are adapted to simultaneously be usable as test leads to measure electric properties. Figure 1 and Figure 4 to 6 display the handling and connecting of the tools. In order to have both hands available to the crafting process, a pin probe has been designed. A cable connecting the pin head to the multimeter allows for temporary, firm contact, without damaging fiber based materials. (Figure 3,5)

As 'means of production' tools determine control and structure the possibilities, shaping the actions performable in any field of making 1. In framing manual craft skills as contributing to the creation of electronic artifacts, they open up the discipline to diverse materials, skills and associated user groups. Crafters can fully execute their skills, being informed already during the process about the electric values of the artifact in production. When crocheting with conductive or resistive yarn, the multimeter can directly give feedback about the conductivity or resistance of the line being crocheted, being connected to the piece through the crochet hook. (Figure 1) Another example would be a routine of using a seam ripper, a tool to cut wrong stitches. The connectivity of seams can be tested and a wrong connection immediately be cut when detected, instead of switching between different tool spaces. As tools of physical manipulation and electronic measurement, they render the processes of crocheting, stitching or embroidery also into an act of engineering. They position the textile construction and the interpretation of electric measurement results to be equally contributing factors to the electronic textile artifact in creation.

Discussion and Conclusion

While crafting with conductive materials is not new, direct feedback about the electronic properties integrated during the crafting process breaks new ground in handling them. The constructive work does not need to be stopped in order to be aware, and if necessary, adapt to the electric necessities. The scenarios enabled by the tools introduced here demonstrate the potential of blending the tacit knowledge embedded in manual crafts with explicit electronic goals. The crafting of a textile electronic

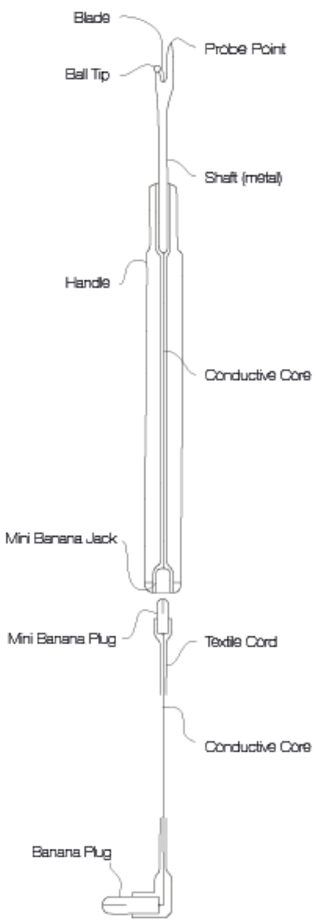

Figure 7 Example of an electronic textile test lead tool: Schematic drawing of a connectable seam ripper, connecting to the multimeter through mini banana plugs at the end of the handle.

artifact is becoming an integrated routine of tactile and informational feedback allowing for multifaceted reflections in action during the making process 9.

It is important to note that the connectable textile testing tools do not exclude the electronic functionality expected from multimeter probes, but they are specifically inclusive of textile materiality. For engineers, this is an invitation to include new materials and processes in their practice. For crafters it is a potential entry point to electronic making, valuing expertise in a new domain. New tools could also provide new approaches to STEM and STEAM oriented education, explicitly supporting individual craft creations in the field of electronic making and providing learners with new angels towards technology creation and understanding. While here examples from the domain of textile electronic making have been introduced, other craft disciplines could be suitable for similar explorations. Overall, a practice incorporating new tools has the potential to shift the attention towards new possible user groups, knowledges and materials to become relevant contributors to emerging physical, tangible and ubiquitous technologies. It will be specifically interesting to further study the emerging cultures of technology production and use.

Acknowledgements

This research has been initiated in collaboration with Ebru Kurbak, Hannah Perner-Wilson, and Mika Satomi as part of 'Stitching Worlds' an artistic research project funded by the Program for Arts-Based Research (PEEK) of the Austrian Science Fund (FWF) at the University of Applied Arts Vienna.

References

1. Glenn Adamson. 2013. *The Invention of Craft.* Bloomsbury Academic, London, UK.
2. Leah Buechley, Mike Eisenberg, Jaime Catchen, and Ali Crockett. 2008. The LilyPad Arduino: using computational textiles to investigate engagement, aesthetics, and diversity in computer science education. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '08). ACM, New York, NY, USA, 423-432. http://dx.doi.org/10.1145/1357054.1357123
3. Leah Buechley and Hannah Perner-Wilson. 2012. Crafting technology: Reimagining the processes, materials, and cultures of electronics. *ACM Trans. Comput.-Hum. Interact.* 19, 3, Article 21 (October 2012), 21 pages. DOI=http://dx.doi.org/10.1145/2362364.2362369
4. Thérèse de Dillmont. 2007. Encyclopedia of Needlecraft. Project Gutenberg. Retrieved September 12, 2016 http://www.gutenberg.org/files/20776/20776-h/20776-h.htm
5. Garnet Hertz. 2012. Critical Making. Retrieved January 07, 2017 http://conceptlab.com/criticalmaking/
6. Ebru Kurbak and Irene Posch. 2014. The Knitted Radio. Retrieved September 12, 2016 from http://www.ireneposch.net/the-knitted-radio/
7. Irene Posch and Ebru Kurbak. 2016. CRAFTED LOGIC Towards Hand-Crafting a Computer. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (CHI EA '16). ACM, New York, NY, USA, 3881-3884. http://dx.doi.org/10.1145/2851581.2891101
8. David Pye. 1968. *The Nature and Art of Workmanship*. Cambium Press, Bethel, CN.
9. Donald A. Schön. 1983. *The Reflective Practitioner: How Professionals Think in Action.* Basic Books, New York, NY.