The E-darning Sampler

Exploring E-textile Repair with Darning Looms

Lee Jones
Carleton University
Ottawa, Ontario, Canada
Lee.Jones@Carleton.ca

Figure 1: (left) Mending tools: a darning loom for flat surfaces, a weft pick, a darning mushroom for curved surfaces, (right) sampler with (top row) steps 1. Warp, 2. Weft, 3. Tidy, and (bottom row) stretch, power, and touch darned components

ABSTRACT

Extending the life of our clothes is the most effective intervention of all current sustainable textile practices. Taking this into consideration, this paper explores how we can upcycle and repair our clothes with e-textiles, and how to share these techniques with other makers and crafters. To do so the author interviewed 4 visible mending educators about their teaching practices and personal experiences with mending. These interviews were then used to inform the design of the E-Darning Sampler for the TEI 2021 swatchbook, which includes examples of different e-textile darning patterns and functionalities made with darning looms. This paper contributes insights on how to design educational samples for encouraging sustainable making practices.

CCS CONCEPTS

• **Human-centered computing → User interface toolkits**.

KEYWORDS

e-textiles, crafting, sustainability, education

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1 INTRODUCTION

Sustainable interaction design highlights the urgent need for sustainability to be considered in all HCI research [1]. There are two aspects to this: (1) when new objects are made we should consider how they will eventually be disposed of, and (2) when possible we should first aim to re-use existing items [1]. In e-textile research, these issues are especially important because of the ecological impacts of fast fashion and textile waste. In e-textile crafting, upcycling (creative reuse) is more common and has been present in research contexts for the past decade. Many e-textile crafting toolkits [32], such as the LilyPad [2, 24], enable individuals to take clothes and textiles they already have and sew interactive properties to them, taking items that were once to be discarded and turning them into something new and personally meaningful.

While present toolkits are useful for e-textile upcycling, this project focuses on how e-textiles can also be used for repair and decoration by utilizing mending practices. Exploring upcycling and

repair should be a priority since extending the life of our clothes is the most effective intervention of all current sustainable textile practices [13]. E-textile hand crafting and mending practices also have many similarities in that both must focus on functionality as well as aesthetics [22]. In the literature, mending and repair highlight the everyday creativity of novice designers [25] and frame it as a type of "material tinkering" [7]. By leveraging current mending and repair practices, e-textile researchers could better situate toolkits for use by Do-It-Yourself (DIY) textile makers and crafters. Previous examples of this transference include projects such as A Kit-Of-No-Parts [26], e-broidery [12, 14, 33], e-textile swatches and swatchbooks [10, 15, 19, 40], crochet crafted logic [31], PolySense batik or dyeing [16], PinProbes [29], e-textile tailor tapes [30] and Punch-Sketching [21], which all look to textile crafting practices in order to creatively solve e-textile challenges.

In this paper we explore the additive and repair potential of darning and mending looms and mushrooms, and how to share those techniques with others, with the E-darning Sampler. The sampler includes examples of different e-textile darning patterns and functionalities. These tools and techniques create a mix between a small woven and an embroidered textile and enable individuals to weave threads for aesthetic patterns. Darning and mending looms also have the potential to bring e-textile weaving research [4–6, 9, 36, 39] to DIY toolkit crafters through smaller and more easily achievable projects. Finally, the additive toolkit approach enables individuals to use clothes they already own that suit their context, such as size and style, acting as an alternative vision to the manufacturing processes of smart clothing.

To inform the design of the E-darning Sampler, we interviewed 4 visible mending educators on their mending practices and how they teach mending techniques to others. This paper contributes insights on how menders create samples to share their work and how we can transfer this knowledge to e-textile repair.

2 RELATED WORK

2.1 Re-use and Repair in HCI

Current HCI research has evaluated how and why individuals preserve and repair personal items [17]. Maestri et al. [25] frame repair as a form of "everyday design" where the user becomes a designer who demonstrates their creativity and resourcefulness in their ability to adapt objects. This is also demonstrated in the design cycle of re-use. Jackson et al. [17]found that artists who re-use waste in their works go through three stages: Finding and Collecting, Playing and Exploring, and Assembling and Configuring. Durrani [7] noticed a similar design cycle among menders that begins with analyzing and exploring issues, experimenting with solutions, and then making the mend.

2.2 Mending Cultures

As the price of clothing decreases mending is increasingly viewed as a leisure craft activity [37] and an "expressive hobby" [23]. Textiles deemed worth the energy of repair are often favourites [26]and repair strengthens that connection [3]. Menders also tend to have an affinity towards slowness and working with their hands [7, 37] and it's the DIY non-manufactured quality to the results that many are attracted to [3]. Along with an affinity towards an item, many menders also are likely to have other sustainability values such as reducing purchases for ecological reasons [23].

Among menders there are two approaches [7]: restorers, who want to bring an item back to its original state (also known as a static repair [35]), or re-doers, who are interested in experimenting and adding new features (also known as a dynamic repair [35]). Among re-doers and those interested in visible repairs, decorative samples of stitches have been well received as learning tools and for exploring possible mending techniques to incorporate [26].

2.3 Learning New Techniques with Samples

Samplers are rectangular pieces of cloth with example stitches, and have a long history in textile skill sharing and education [34]. Before patterns could be printed, samplers acted as a way of recording techniques for textile crafts such as knitting, crochet, and embroidery [11]. Samplers are also practice pieces, where individuals would emulate the stitches from another sampler for future reference [34]. Along with educational uses, samplers were also used to record childhood autobiographical events and to demonstrate literacy [8]. Current samplers are used for sharing innovative designs and techniques, such as symmetry samplers [11].

In comparison with samplers, swatch books are similarly used for reference material but are commonly used by the textile industry for fabric rather than stitching examples. The swatch book approach of having binders with various material swatches has been taken up by e-textile researchers [10, 15, 19, 40]. The annual e-textile swatchbook exchange is an opportunity for e-textile researchers and practitioners to share samples of their work and learn from each other's techniques [15]. The physical samples are then further supported with web documentation and instructions, but participants in the swatch exchange emphasize the importance of sharing physical work [15, 30]. Swatchbooks have also been used for co-design and teaching diverse fields about what is possible with e-textiles. The "Electronic Textile Interface Swatch Book" [10, 40]was a book with embroidered e-textile sample pages that could be plugged into a computer. Interacting with the physical pages would result in corresponding changes on screen to demonstrate how these soft interfaces could be used. The polish of the samples made the book useful for demos and it was used to co-design e-textile concepts with fashion and textile designers. But swatches do not always have to come in a book. A Kit-if-no-parts [28], Wearable Bits [19, 20], and shape changing samples [38] all use fabric swatch examples as a toolkit (or un-toolkit) for exploring possibilities.

3 INTERVIEWS WITH MENDING EDUCATORS

For this project the researcher interviewed 4 visible mending educators (P1-4) to explore how they use material samples in their workshops for sharing techniques with others. Visible mending educators are individuals who run visible mending workshops. The researcher conducted a semi-structured interview asking participants about the mending techniques they use, the material samples they use in their workshops, and a mend that they were most proud of. We transcribed 2.5 hours of video recording and performed inductive analysis with line-by-line grounded codes for each quote. These were then used to develop themes based on how participants

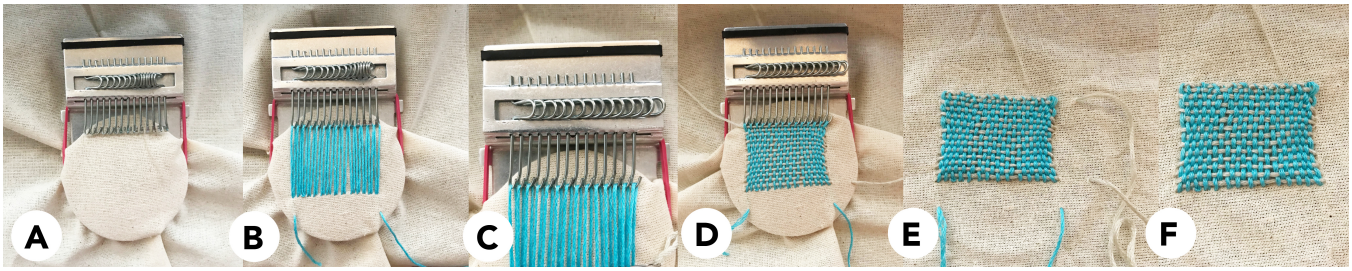

Figure 2: Darning Process: (A) Preparing darning loom on fabric, (B) Warp, (C) Switching warp hooks brings opposing threads to the top for easy threading, (D) Weft, (E) Take fabric off loom, (F) Tidy and knot threads on the back

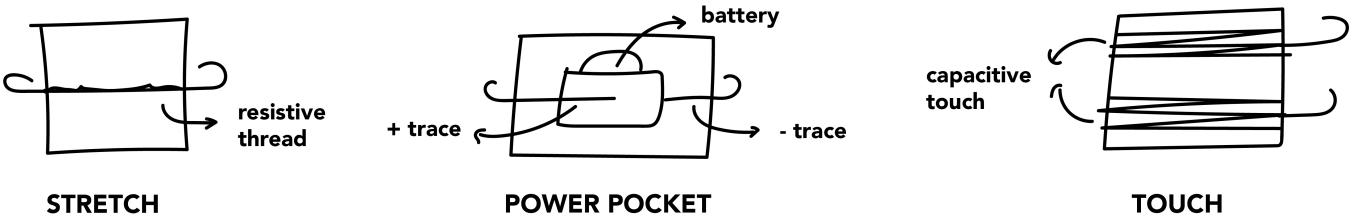

Figure 3: How each component was built (left to right): Stretch sensor was made with variable resistive thread, Power pocket is two layers with traces going in opposing directions, touch is two capactive touch areas made with conductive thread

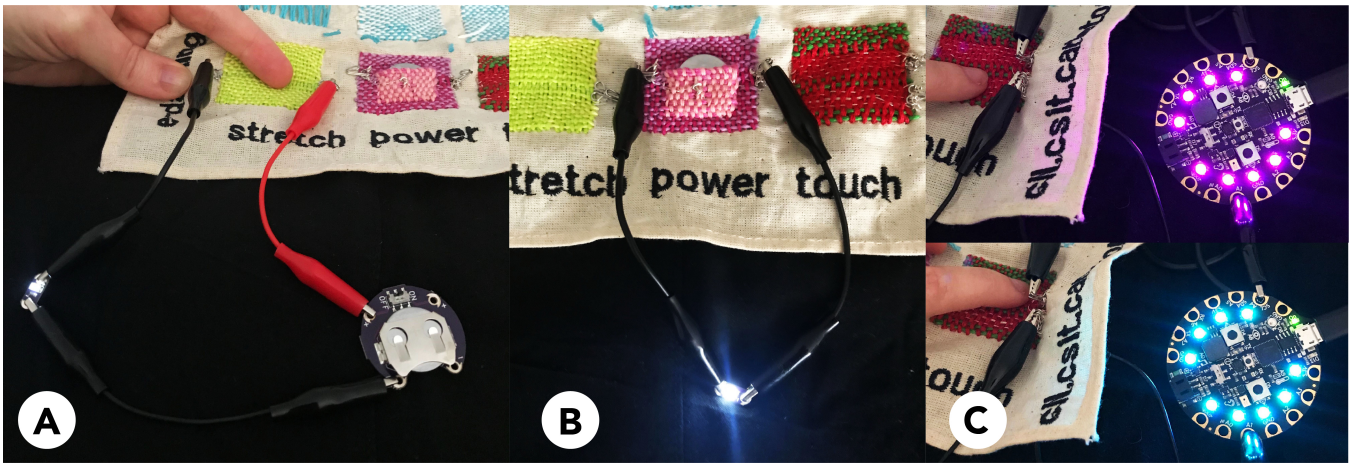

Figure 4: Interacting with the components: (A) stretching fabric makes the thread less resistive resulting in a brighter light, (B) placing a 3V battery in the power pocket will turn an item on, such as an LED, (C) touching different capacitive touch areas turns on different colour lights using a circuit playground microcontroller

used visible mending and how they taught it to others. This project was approved by our university's research ethics board.

3.1 I Repair Because I Care

All of the educators we interviewed got into mending by wanting to enhance or repair a favourite item of clothing. P2 described feeling "heartbroken" after a rip and "trying to find a surrogate, like something that would kind of fit, and I just gave up". As P1 states, "it speaks to our need to touch and be with fabrics that are meaningful to us – to spend the time to make something look worn as well". They also discussed how mending had become "part of my style" [P3]. P4 highlighted how visible mending was a way to personalize clothes to make them something "no one else is going to have". All educators had also noticed a resurgence in visible mending coinciding with environmental concerns. "There's something big changing. And I think it is correlating with how we feel about the fashion world and what we're ready to do about it" [P1]. There's also an awareness of the impacts of fashion where "people are more

conscious that fast fashion is really bad for the planet" [P3] and "you want to try and extend [your clothes] as long as possible" [P4].

3.2 Mending is Problem Solving

Mending workshops always began with investigation. As P1 states, "It's kind of like we become detectives about it, like how did this hole happen in the first place." During their workshops the participants would ask attendees to bring in their own worn items and they would spend the workshop analyzing and addressing the wound. This analysis took into consideration how they "wear those clothes" [P1], "locating stress points" [P4], "how to mimic the fabric" [P2], "strategies for repairing" [P4], and "making the [patch] large enough" [P1] so it doesn't rip again. Mending was as seen as learning through doing. As P2 states, "Let's just fix it. Let's just figure it out."

3.3 Materiality of Learning

All educators discussed their preference for teaching in person, and that mending "is a very tactile, hands on thing" [P3]. Learning with groups was also important "there's a little bit of that interconnectedness that I miss, and I don't know how to fix that" [P3], and "they just love stitching together to. So, I think there's that camaraderie [P4]". All participants brought physical samples to classes to demonstrate techniques and processes. Two participants presented samples that showed the steps and progression of specific techniques. Participants also used different coloured threads to highlight stitches for comprehension. All instructors brought "mending museums" [P1] of clothing with different mends to demonstrate how to solve specific problems.

4 THE E-DARNING SAMPLER

The E-darning Sampler leverages these interview insights in several ways (See Figure 2,3,4). First, through demonstrating a variety of functionalities to support the different types of mends that might be needed, such as accidental rip when an item gets caught on something versus the wear of an elbow. The touch sensor might be useful for a point of wear, whereas the power pocket for an accidental rip, and the stretch sensor for a cuff or sleeve. For comprehension and learning I've added the process steps of darning, using different colours of thread to demonstrate different stitches, and labelling each step and technique. The aim of this work is to further research on extending the life of our clothes and the customization opportunities of upcycling toolkits [18]. Future work could explore the E-darning Sampler as an educational tool for mending in-situ, with evaluations for placement and wear over time. We also plan to explore other mending opportunities such as stitching patterns and patches, such as Soft Speaker patches [27].

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