

Exploring the Role of Textile Craft Practice in Interdisciplinary E-Textiles Development through the Design of an Illuminated Safety Cycling Jacket [†]

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Abstract: Most E-textile research tends to fall within the arts or science disciplinary boundaries, despite E-textiles themselves being interdisciplinary in nature. This work explores how contemporary woven textile practice methodologies can play a role within interdisciplinary research, expanding the creative and technical applications of materials and technologies. A team of electronics, textiles, and fashion specialists was formed to design and make an illuminated jacket for use by cyclists. The jacket incorporated bespoke woven panels that integrated electronic yarns within the pattern. The development of this prototype raised questions about the use of craft practice methodologies in the development of new E-textiles.

Keywords: textile craft practice; cycling safety; electronic textile; E-textiles; LED; light-emitting diode; illumination

1. Introduction

This work presents the author's reflections on using textile craft practice as an approach for developing electronic textiles (E-textiles). This is framed within the context that one of the roles that contemporary textile practice can play in research and innovation is to explore and expand the creative and technical applications of new materials and technologies. This is evident in other disciplines, such as ceramics and jewellery, where craft practitioners have been able to take new materials or technologies and, through expert knowledge, devise production methods, or expand the range of possible applications [1].

In E-textile research, there remains an opportunity for further exchange between technical and creative practitioners. There is a division in research outputs that can be grouped into either the material sciences, 'scientists, technologists, and industrialists' or the materials arts, 'designers, architects, media, craftspeople, and artists' [2]. Therefore, despite the field of E-textiles being interdisciplinary in nature, research conducted in this area does not fully reflect this.

The question that this research project posed was: "How can woven textile craft practice be used in the development and innovation of E-textile products?" An interdisciplinary team consisting of fashion, textile, and engineering specialists was tasked with developing a 'wearable' prototype incorporating light-emitting diode (LED) embedded electronic yarns (E-yarn) [3]. Based on the team's

experiential design knowledge and a gap in the market for fashionable, functional E-textile products, the main aim of the project was to develop a safety cycling jacket (the Light my Elbows cycling jacket). The final prototype produced can be seen in Figure 1 and was presented at Textiles Intersection Conference 2019 [4].



Figure 1. Light my Elbows cycling jacket incorporating LEDs within electronic yarns in the elbows.

2. Production of the Cycling Jacket

The Light my Elbows cycling jacket was developed and produced by a team (the authors) that included experts in pattern cutting, embroidery, circuit design, garment design, and electronic textiles. The design of the final prototype was influenced by all of the members of the team and their individual concerns and expertise. Decisions were made from a user-centred design approach [5], and the placement of the LED's was influenced by emerging literature in cycling safety about biomotion as a strategy for increasing conspicuity and visibility [6].

The overall methodological framework was a creative, practice-based research approach, building on previous collaborative E-textile projects [7] and utilising the process of reflection in, and on, action as a means of analysis [8]. Within the context of the interdisciplinary team, each practitioner–researcher also followed the standard practices in their separate disciplines. This work focusses on the weave practice; a more rounded account of the project can be found at [4].

The LED E-yarns produced in this work were created using a semi-automated production method, similar to the process detailed in the literature [3]. The E-yarns were produced by soldering white LEDs (LNJ047X8ARA; Panasonic, Kadoma, Japan) onto thin copper wires and then encapsulating the LED, solder joints, and supporting yarns within a resin micro-pod. The micro-pod, supporting yarns, and wires were then covered in a braid using a Herzog braiding machine (RU1/24-80, Herzog GmbH, Oldenburg, Germany) and fluorescent orange (PGCD050) textured multifilament polyester yarn (1/167 dtex; Ashworth and Sons, Cheshire, UK). The overall diameter of the final LED-yarns was 2 mm.

The bespoke woven fabric, which contained the LED-yarns, was to fit the sleeve pattern piece of a cycling jacket. The fabric was hand-woven using a TC2 digital jacquard loom (Tronrud Engineering, Hønefoss, Norway). The fabric was a geometric double-cloth construction, with the warp made up of dark grey (PG812) and fluorescent orange (PGCD050; 1/167 dtex), textured, multifilament polyester yarn (Ashworth and Sons, Cheshire, UK), and a weft consisting of the same polyester yarns with the addition of retroreflective yarn, and the LED-yarns described above.

3. Textile Design Craft Practice in Developing E-Textiles

In practice, textile designers develop their 'artistic skills, craftsmanship, and technological knowledge' simultaneously [9,10] so that, from the beginning, these differing facets of textile design were considered to have equal importance. In weave practice specifically, composition (design) and construction (craftsmanship) are parallel processes on and off the loom, and it is the growing

experiential knowledge of the weaver that enhances their ability to simultaneously negotiate the demands of each aspect [11]. As knowledge is created and passed on experientially, there is a reliance on the haptic qualities of textile materials and construction processes in the design of woven textiles [12]. The first stage of developing the E-textile involved an iterative sampling approach where knowledge about the material qualities of the LED-yarn and resulting fabric was gathered. Various construction techniques were attempted for integrating the E-yarn with varied results. In this context, ‘success’ of a sample considered not only the judgement of the textile designer, as is normally the case, but was also influenced visually and functionally by parameters set by the needs of the garment design, and the functional requirements and capability of the electronics being used.

An essential method used to communicate across disciplines was the use of representative objects such as samples, props, and other visual aids as the language used by individual practitioners does not always translate, even within the creative disciplines. Figure 2 shows one element of the design and illustrates the process from concept to the final fabric. Dummy E-yarns were used on a toile (test garment) to plot the placement of the LED-yarn. Figure 2a shows the initial design of the sleeve which was carried out using a toile of an early version of the garment; placing dummy LED-yarns on it. This directly influenced the digital translation of this placement into a digital weave design, Figure 2b, resulting in the final fabric construction, Figure 2c, which was used in the final construction of the prototype.

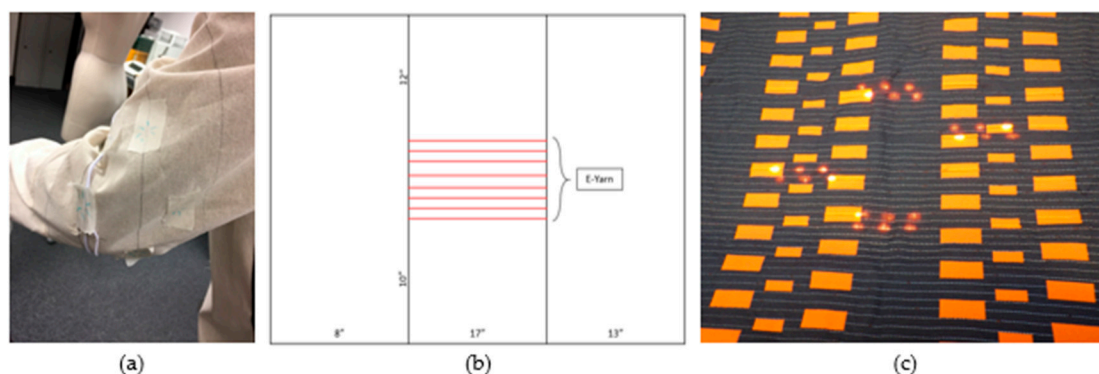


Figure 2. Some of the process used to integrate the LED-yarn into the cycling jacket sleeve. (a) Initial design idea for integrating E-yarn. (b) Garment pattern translated into digital file so that E-yarns were correctly placed in the sleeve. (c) Final woven fabric before being cut and sewn to create the sleeve.

4. Conclusions and Future Work

A cycling jacket including LEDs embedded within E-yarns was produced; alongside this, the beginnings of a framework for interdisciplinary E-textiles research, from a weave practice standpoint, were identified. This involved using samples, prototypes, and other visual aids as a common language, rather than relying on the technical language used in the different subject areas. This first prototype will feed into further collaborations in which future iterations of the prototype will be produced.

More directly, this research fed into a more focussed investigation of the way in which weave craft practice can make a deliberate and measured contribution to the field of E-textiles. The experiential knowledge that weave craft practitioners hold gives them textile construction knowledge that could prove valuable in trying to improve the level of integration of electronics in textiles. The framework which the textile designer works in holistically considers not only the fabric design and construction, but also the wider context, considering that technical, cultural, and design elements may also help commercially better place E-textile products in the market.

In future work, the qualities of the weave design and construction to enhance the illumination performance of the LEDs integrated into the E-textiles needs further consideration. Figure 3a shows the beginnings of this work; here, a honeycomb weave structure was used to ‘cup’ the light so that the perceived brightness of the LEDs is enhanced, even behind a layer of fibre. Quantitative measurement of the performance of the LEDs will be used alongside the creative practice-led

methods, an element distinctly lacking in the initial work. The connections made between the electronic elements in the E-textile products also require further development, as this is currently an area of structural weakness (see Figure 3b).

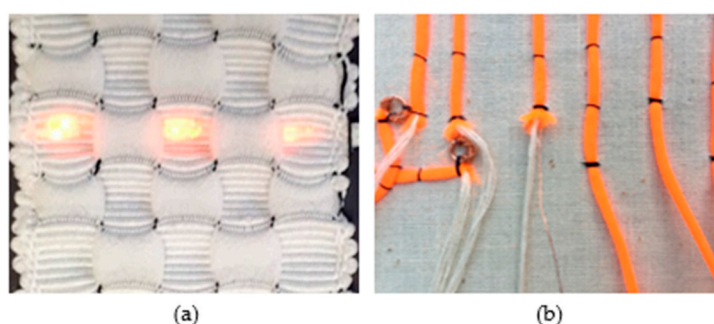


Figure 3. Future research areas for woven E-textile development. (a) Exploration of LEDs integrated into textiles. Here, a honeycomb weave structure has been used to enhance the perceived brightness of the LEDs. (b) Connections made between the electronic elements are currently a point of failure and soft connections, using textile techniques for connecting electronics, need to be explored.

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