Electric Corset: an approach to wearables innovation

Sarah Kettley, Katherine Townsend, Sarah Walker, and Martha Glazzard
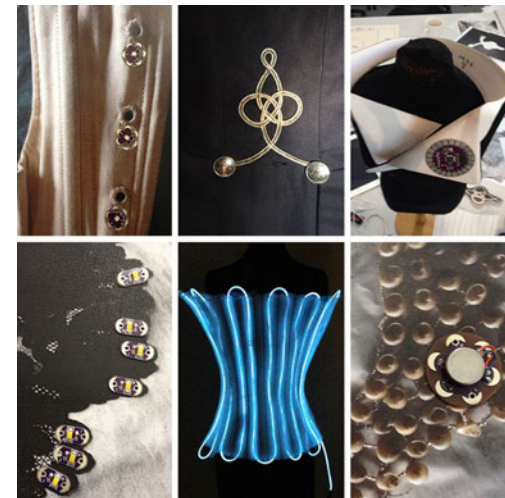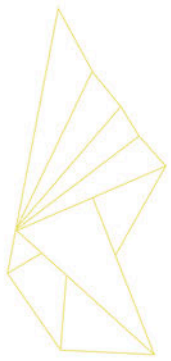
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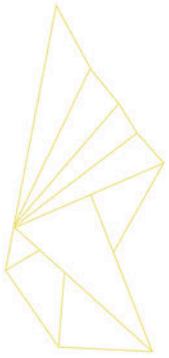**Sarah Kettley [1], Katherine Townsend[2], Sarah Walker, and Martha Glazzard**

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Abstract: One criticism of electronic textiles and wearable technology is that instead of being integrated into the modern wardrobe, the electronic garment is perceived as the 'other', as an 'unusual' item within the wardrobe. Contemporary fashion is a field of play in which individuals constantly manage personal expressions of social belonging and transgression, at the same time as it closes down the potential for new forms as a result of increasingly fast fashion supply chains. The Electric Corset project proposes that the uptake of wearables is compromised when development is based on modern categories of dress/dressing, and proposes that designers look to obsolete and 'in-between' items of dress to rethink the foundations of wearables development. In collaboration with Nottingham Museums and Galleries Costume and Textiles Collection, we have reproduced a small selection of such items, and recast them as 'sacrificial' toiles to provide a non-precious basis for embodied experimentation. The paper describes some of the barriers to innovation in wearable technologies, and frames our approach through the twin concepts of deconstruction and reconstruction in fashion theory. It reports on our experiences of embodied responses to the toiles within the making process, and presents early findings from a pilot study using improvisation.

Kettley, Townsend, Walker, Glazzard | The Electric Corset; layering toiles, paper images and electronic components for creative wearables inspiration

Introduction

This paper reports on an ongoing project, *The Electric Corset and Other Future Histories*, established by the authors in 2014. The title was inspired by a late advert for Dr Scott's electric corsets from 1883, designed using 'scientific principles' and powered electro-magnetically to enhance health and wellbeing (Art and Picture Collection 2014). Based on Parisian corset models (fashion) and powered by English electricity (technology), this historical artifact provides a strong metaphor for wearable technology and the aims of the project to develop novel, interdisciplinary methodologies for wearables innovation. The project responds to the need for the designerly integration of electronic textiles with wearable concept design, optimising both the aesthetic potential of, for example, surface embroidery, and e-textile functionality. To date the uptake of wearable technology as fashion has proved problematic, with smart garments and accessories that perform particular functions often being seen as gimmicky, and restricted largely to the red carpet, stage, or niche sports markets. One of the reasons we have identified for this lack of mainstream, 'everyday' success, is the assumption that a wearable should comprise a whole system (input-processing-output) in one garment, which then becomes experienced as 'other' in the contemporary wardrobe. In general, today's fashion system presents limited scope for interventions; the popularisation of T-shirts and jeans through mass culture, the practical turn in women's clothing, the rise of unisex and 'classless' styles (Laver 1995), all contribute to the streamlining of high street silhouettes and outfits that merely simulate functionality through faux pockets and button stands for example, in the name of narrow margins and a modernist aesthetic. The designing out of constructed details and modularity has resulted in fewer opportunities for designers to convincingly contextualise technical enhancements. It is for this reason that we are looking to past categories of dress and practices of wear, to inspire and help us identify potential spaces between the body and clothing, where actions, objects and technology can co-exist. Based on this premise, the authors are working with historical garments and fashion items from the Costume and Textiles Collection held by Nottingham City Museums and Galleries at Newstead Abbey, Nottinghamshire (Figure 1).

This paper is organised in five sections; the first contextualises the area of wearables, through references to creative research practice relating to fashion and technology and the conceptual framework of deconstruction and reconstruction. The following three sections document our 'research through design' practice. In *The Role of The Archive*, we cover initial visits to the costume and textiles collection under the guidance of the curator (Figure 1), the ensuing creative ideation process based on visual research (drawing, photographs, video) (feature image), the couture practice of moulage (draping, working directly with complex forms on the body) (Figure 2), and the creation of an installation comprised of visualisations of wearables and historical artifacts shown in the exhibition *Crafting Anatomies* (2015). Section three reports on follow up visits to the archive,
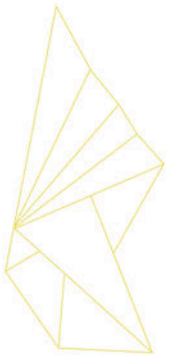
and the selection and replication of items to produce 'sacrificial toiles' (Figures 3 and 4); this section describes our own embodied responses to the making process, and reflects on what it made possible. The fourth section depicts how pocket toiles were further developed to drive the integration of interaction design concepts (Figure 5), contexts of use, and suggest creative technological solutions. Finally, we report on a pilot
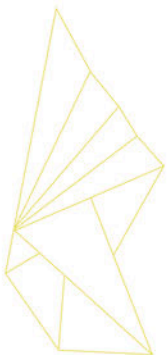

Figure 1. From the archive at Newstead Abbey: footman's livery with gold braid, and a selection of collars. Photo credit: Katherine Townsend.

study and outline performative evaluation methods for further work.

Wearables and the Creative Process

The design of 'wearable technology' can be a paradox, as the *wearable* and *technological* aspects are often designed separately, resulting in electronic textile components that operate independently from perceived and actual wearing practices. The integration of technology with a tried and tested fashion item can constitute a 'decorative' approach, where the electronic element is viewed as an enhancement of the garment 'canvas' (Townsend 2011). The bringing together of two contrasting technical concepts can result in prototypes that are more artwork, than a functioning item of clothing. In 2005, Stead identified the need for further research from a 'fashion perspective' to be undertaken in the emerging area of integrating smart materials and electronics with the body through the project *The Emotional Wardrobe*. The research explored fashion's capacity to be emotionally expressive through the added interface of technology facilitated via the 'AffectiveWare' platform, developed through a multi-disciplinary framework combining fashion, material science and real-time, affective computing (Stead 2005). This work shifted the emphasis on wearable technology to be informed by human-computer interaction, towards 'a more poetic…computer-aided, human–human communication.' Rickard Lindqvist's research into 'kinetic garment construction' (2015) is based on the interactions that occur between draping the moving body in cloth, and how this can inform the shaping

and cutting of fashion that accommodates bodily expression, as opposed to basing styles on preconceived principles. Lindqvist's methodology 'challenges the fundamental relationship between dress, garment construction, and the body, working from the body outward, as opposed to the methods that are based on the prevalent paradigm of the tailoring matrix, which work from the outside toward the body (Lindqvist 2015: 6). This reverse-engineering approach (Ibid. p.104) is also basis of his collaborative label, *Atatac* which challenges existing modes of designing, visualising and producing fashion by making each stage of the process transparent (Atatac 2016). This philosophy raises parallels with deconstructed fashion - how shifting the accepted parameters of the fashion system by exposing the raw ingredients and inherent processes (body, gesture, materials, making) can lead to a different kind of fashion/ technology, which is more responsive to the human condition. Martin Margiela's interpretation of 'time and the body' is evidenced through the history of a garment, made 'visible through the externalisation of the production process' (Verhelst & Debo 2008: 8); his use of replica archetypal Western garments, such as the trench coat, tuxedo, white blouse, and jeans, has parallels with this project's reimagining of past dress codes in a new context, while Lindqvist's deconstruction of the archetype itself informs our eclectic approach to the archive, and the creation of new narratives through the use of 'in-between' things, which elude simple categorisation as garment, jewellery or accessory.

The team included a digital print and fashion designer, a digital jeweller and interaction designer with textile-based wearables experience, a mixed media textile designer with e-textile experience, a knit expert with e-textile experience, a pattern cutter with collaborative experience on wearables projects, and a visiting interaction design artist from another project. Not only did we see opportunities for the development of a wearables design approach informed by different cultures of dress, but we also understood the need for ourselves to continue developing hands-on embodied knowledge of the materials of fashion, physical computing and wearable technology, that is, to continue working towards interdisciplinary rather than merely multidisciplinary collaborative practice (Kettley et al 2015).

The Role of the Archive

The title for the project was based on an advertisement for a Victorian 'electric corset', which represented a wearable innovation from the past. The original aim of the research/ practice was to demonstrate the wealth of historical artifacts and references available to designers of smart textiles and wearable technologies by considering the anatomy of dress as a catalyst for future wearable designs through an annotated physical anthology of historical artifacts and speculative prototypes (Kettley et al 2015). A process of selection was initiated in late 2014/early 2015 through visiting and studying items held by Nottingham Museums and Galleries Costume and Textiles Collection (based at Newstead Abbey) in
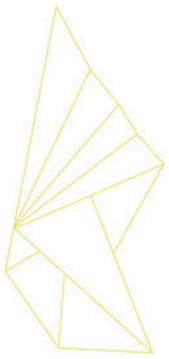
collaboration with the curator of Costume and Dress, Judith Edgar. A small collection of pieces was chosen for exhibition as part of *Crafting Anatomies* (2015) (feature image); these pieces comprised a white twill ('jean') woman's corset (jumps) (1800-1810), a woman's dress collar, embellished with shells and glass beads (1920-30), three detachable men's starched linen shirt collars (1850 -1952) and a footman's livery coat (1890-1910). As part of this engagement with the archive, themes began to emerge which we believe could inform novel design processes for future wearables, including functionality, care and maintenance, details denoting class and identity, and modularity and layering (Kettley et al 2015). The garments in the exhibition were accompanied by a film that communicated the research methodology through still images, short video clips and quotations. The content included photographs of the garments and accessories (taken in the archive) and documentation of the process of experimental ideation, or 'play' inspired by the construction and decorative details of the items (Glazzard et al 2014). For example, the boning and ten-hole lacing of the corset; buttons, fastenings, pockets and decorative cording of the footman's jacket and collar shapes inspired 2D drawings, collages and material sketches and assemblages. 3D partial garments were 'moulaged' (Duburg and van der Tol 2008) by working on the half and full-size mannequins using cloth manipulation, stitching, smart elements such as basic circuits incorporating LilyPad (Arduino) and SMA's (shape memory alloys) (feature image and Figure 2). This crafts-driven creative prototyping employs some of the principles of Kettley's 'foundations of craft', which include: 'risk and

visual language', 'extending material' and the 'internalization of material' (2012). It also prioritises hand making as a 'way in' to the programming and use of digital tools (Taylor and Townsend 2014).

Figure 2. 'Moulage' process on the stand with mixed media and electronics. Photo credit: Walker and Townsend.
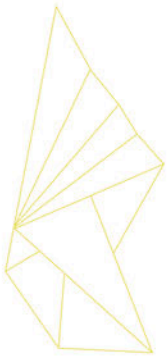
Embodied responses in research through making: from untouchable to 'sacrificial' materials for design

An archive is an inactive place, full of stillness, and things decontextualised and held in stasis, waiting to be brought back into play (Latour 2007); we see in these things clues and opportunities for future dress practices (Entwistle 2000). However, things taken from archives are precious, often fragile, and handled with kid gloves and wrapped in acid free paper. In accessing these things we found that we had no hands-on interaction with the garments, but experienced them virtually through the hands of the curators. We therefore needed to develop our own physical instantiations so that we could playfully recombine garment pieces and ambiguous wearable objects without fear of damage. This paper focuses on the creation of these deliberately 'sacrificial' toiles, and our embodied responses to them.

In the context of wearables development, 'sacrificial' is used to remind ourselves to be playful, and that toiles, even when they have functionality, are non-precious, and seen as starting points rather than ends in themselves. This challenges conventional design practices in which a tangible outcome is usually required, or held as a final product.

This approach shares similarities with creativity exercises in other fields, such as making sketches only to then destroy them (in foundation art and design studies), or even the metaphorical throwing away of research questions (in practice-based doctoral training). It certainly sits in opposition to the perceived value, if not reverence for, the investment of time and financial cost in getting physical circuits to work in wearables development (as an aside, the silversmith/jeweller on the team seems to find this less problematic, perhaps being more accustomed to working with 'precious' materials).

Building on the *Crafting Anatomies* exhibition (2015) moulage stage, the first step was to recreate the selected 'in-between' things from the archive as toiles. Secondly, by looking at the points where parts of garments attach to each other and where things layer on the body, we can begin to map the points at which, through interaction, the wearer defines both their expression and their function (Figure 3). This approach has the potential to inform the placement and construction of electromechanical contact points, which could include e-broidery techniques, soft switches, and creative use of haberdashery and jewellery findings.

Figure 3. 'Sacrificial toiles': The pocket archetype takes on two different personalities ('generous' and 'neat') as a result of their construction, suggesting functionally and qualitatively different interaction concepts. Top row: when filled, the circuit in the generous pocket circuit is broken to light the LED. Bottom row: the conductive fabric ring completes different circuits inside the neat pocket to light different LEDs. Photo: Sarah Walker.
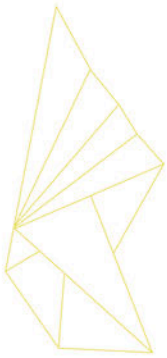
In making, all the toiles were 'bagged out', to provide spaces for electronic components to hide; the researchers' experiences on related projects informed shared discussions during the making process, about possible connections, sensors and switch types that the forms brought to mind. We saw potential in lace collars for capacitive switches based on touch, with proposals for mixing conductive inks and non-conductive yarns (Figure 4). A chatelaine became a sort of 'plug and play' wearable, lashed up with interchangeable objects each having a defined function ('*lash-up*' is used in circuit design to refer to quick and dirty testing methods, such as using crocodile clips). The original includes a pin cushion, eternal calendar and embroidery scissors; an electronic version might be thought of as a physical analogy of the apps on a smart phone, or include the items that would be needed to maintain a wearable system – batteries, spare press studs and miniature sewing kit (Figure 4). Two of the researchers made short videos of themselves putting things on, and thinking through action and interaction. Four workshops were organised amongst the makers, building ideas and ways of mocking up the application of electronics and circuits to the forms. A simple capacitive sensor was created, for example, using pins and conductive fabric together with an Igloo board (Microsemi 2016). Crocodile clips and Velcro were used to prototype different placement layouts across (and within) garments, and with the larger pocket and the sleeve toiles. Problems with pinning electronics for mocking up were overcome by 'working
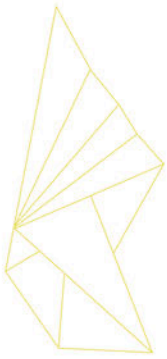
backwards' and revisiting the multi-media layering techniques developed in the first stage of the project, and concepts were saved and


Figure 4. 'Sacrificial toiles': (top row) lace collar inspired capacitive switch using conductive ink; (bottom row) chatelaine with pin cushion, embroidery scissors and perpetual calendar, and 'lash-up' using Igloo processor board and crocodile clips, to which different sensors or outputs could be connected. Chatelaines were common in the nineteenth Century and were worn clasped at the waist; useful items were suspended on chains from the clasp. Photo: Walker and Glazzard.

communicated using photographs and video recordings.

At this point however, we recognised the danger of being caught up in issues with the electronics such as developing new programming skills, and getting microcontrollers to work properly, when the questions were more about how items are worn and interacted with on the body. To bring the project back on track, the team discussed two possible ways forward: either we could recreate a whole outfit, demonstrating connections and layers which could be developed as connectors in electronic systems, or we could focus on the toiles we had made, and explicitly use them to orient our thinking. A meeting was organised, at which all the toiles and mock-ups were laid out for handling while talking.

This made a huge difference to our ability to share knowledge, and to respond in an embodied way to the materials and forms of the pieces, rather than our own preconceptions of what wearables should be like. As a result, the decision was made to focus the next part of our novel methodology on embodied interactions with the two pocket toiles, one of which felt generous and baggy, and the other, flat and neat, almost 'prissy' (Figure 3). We felt the larger form almost asked to be filled full up with things, while the flat pocket suggested quite a flat, sliding motion of the hand into it, against the body. In turn, this led us to think about what kind of circuits might be involved; thus we propose that the construction of different physical forms of the same archetype (in this case the
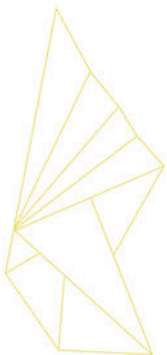
pocket), can suggest different body-led interaction design concepts, which in turn determine expressive functionality and the arrangement of electronic components.

This was a process of abstraction, of taking the worn thing out of its normal context, in order to explore its own materiality phenomenologically, without preconceptions as far as possible. It was effectively a process for 'making strange', of defamiliarising ourselves with them, in order to see them afresh, or even at all. This tactic can be seen in ethnographic practices, used to overcome researcher blindness to over-familiar situations (de Jong, Kamsteeg & Ybema 2013); indeed, the tactic can also be seen developed in Situationist art practices such as *dérive*, in Europe in the 20th Century (Ejsing-Duun 2016). In removing the conceptual model we bring to the interaction, we create the space for new reconstructions of meaning and use. In the case of the pockets, for example, we realised that we might be talking about not only *making*, but *breaking* circuit connections. Simple circuits, without processors, were made with the pocket forms.

Figure 3 shows these: the first is the larger, 'generous' pocket, with a collection of things that to be accumulated within it – when it gets full (of non-conductive objects), the circuit is broken, and there is an output (an LED, for demonstration purposes); the second is the flatter pocket, which is activated by a second wearable artifact, a simple ring of conductive material, which closes a circuit.

These now demonstrate the potential of the same archetypal form – the pocket – to inspire different interaction design and physical computing design concepts and specifications through embodied responses to simple 'sacrificial' toiles. Importantly, as the methodology continues to develop, the toiles, in various states of electronic complexity, need to remain 'sacrificial' so that we can work with other people.

We now report on the pilot study that used movement and performative methods so that the creative playfulness of the 'designers' is transferred into a context that supports the creativity of the wearer.

Provisional Findings from a Pilot Study

We were influenced at this stage by 'Potato Theatre', 'Object Theatre' and Improvisation in theatre practice, as ways in which new and unexpected narratives can be constructed in relation with objects (Buur & Friis 2015, Johnstone 1989). Each of these forms of theatre craft aim to "encourage the rediscovery of the imaginative response" to objects, and to human relations with and through objects (Johnstone 1989:9). Such approaches have been emerging in Interaction Design for some time, and Walker attended a recent doctoral summer school at the Design School Kolding, to experience Potato Theatre first hand.

To trial these methods, three fellow researchers were invited to play with the objects in relation to their bodies, to explore ways of wearing them and talk aloud about how they felt, and what types of interaction or
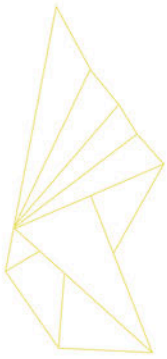
functionality they imagined (Figure 5). These respondents had a range of experience in textile design, wearables market research and development. Questions such as "What should I do with this?" and "How does it connect with the body?" were posed as starting points and the respondents were video recorded. The respondents did not know what to expect, and brought their own perspectives strongly to bear on these questions. For example, one individual discussed everything from a styling and fashion communications perspective, while another (the embroiderer) responded to the textures and surfaces.

The main themes to emerge include observations on mannerisms, gestures and demeanour, which appear to be affected by the forms and interactions of the toiles and mock-ups; and emotional dimensions of body posture and what Goffman (1959) termed 'given off' impressions of the self in social situations. For example, one respondent described standing with a clenched fist in the larger pocket because she felt shy.

Figure 5 is an attempt to capture the movements different forms ask the wearer to make – to tie a fastening, or to access the opening of the pocket – or the demeanours they afford once on the body, such as standing with hands on hips.

Although these are interesting starting points, we are not convinced that we managed to "break patterns and come up with yet unknown ideas and solutions" (Buur & Friis 2015:4). We are therefore keen to develop the methods further, by working with theatre practitioners. The framing and direction of improvisation and object-based work are skills we recognise we do not have, and so a one week creative workshop is planned in the final week of March 2017 with collaborators from the Academy of the Arts, Amsterdam, and colleagues from the Design for Performance programme at the authors' own institution.
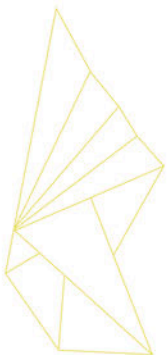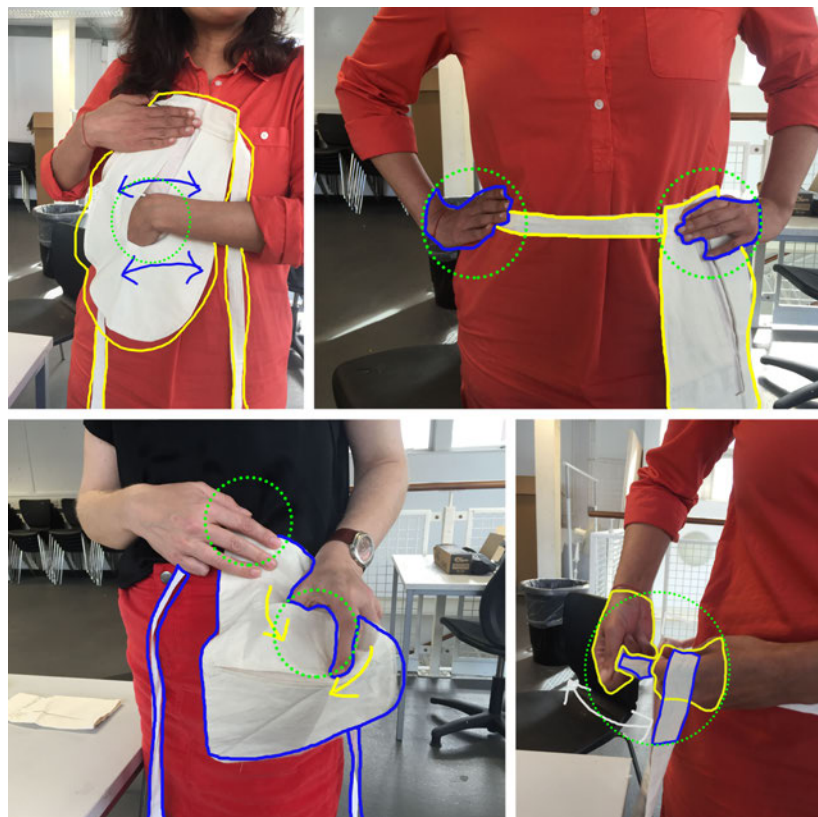
Figure 5. Dressing workshops with respondents; exploring expression and functional potential through the body and demeanour. Analysing where the objects are touched and manipulated when worn. Photo: Sarah Walker.

Reflections and future work

In contemporary fashion and the context of the contemporary wardrobe we have been unable to find enough potential to animate the creative dress acts of the future. This paper presented a novel methodology for the design led development of wearables that might help to address this issue, through working with archives, deconstructing and reconstructing garments and 'in-between' garments through the use of 'sacrificial' toiles, defamiliarisation techniques, and potentially, improvisational techniques for evaluative narrative construction with wearers. The value of embodied making practices is highlighted through the use of a single archetype wearable form (the pocket) with quite different personalities, interactions, demeanours and subsequent physical computing specifications. Finally, the methodology presents a viable way of working with visual and tactile concepts of craft to further the field of wearables design, and pre-empts the invention and availability of specific technologies by considering identity and expression as functions of clothing and adornment. We believe it could make wearables more feasible to produce, as they become modular, with 'plug and play' functionality, and thereby contribute to the innovation process and everyday take-up of wearables and electronic textiles.

Just as the respondents in the pilot research based their responses in their own fields, so have we found ourselves at once implicitly bounded by our own experience, and under imagined pressure to make complex

circuits where they are unnecessary. We are aware of, and have experienced hacking in the more traditional sense, where electronic products are torn down and recombined, and one of the authors is a member of the local Hackspace. We have tried to extend this mindset throughout the design process to include all materials – the inspirational historic garments, the pattern cutting, and toiles, and even the body. We are striving to keep on opening up each step of the process in order to develop the creative methodology, rather than arriving at objects that are ends in themselves. This is difficult when the technology is quite new to some of us, or when it feels too 'precious' or even beautiful to hack. The next steps include a set of deconstructed shirt-dress forms that can be reconstructed to create variations on a circuit. These are to be shown at RTD2017, when we will test a second iteration of our framing of users' improvisational interaction with the shirt-dresses, before taking them to the theatre methods workshop at the end of March. We do not claim insights for the wider design community from our approach, as creative, lateral thinking, and reframing techniques are not new in this field; however, perhaps our work will demonstrate how quickly wearables have become thought of as only wrist or head-worn, and characterised by the formal language of industrial design, and a narrow use-value approach to an expressive design opportunity.

Acknowledgements

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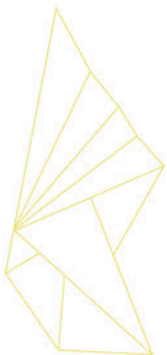
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