

# Decoraction: a Catalogue for Interactive Home Decor of the Nearest-Future

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## ABSTRACT

Home decor defines how people experience and share spaces, with the decorative elements forming the ‘interface’ to the home. Despite the opportunities of embedding technology within these elements, research to date has not explored this fully. This paper brings home decor to interaction design utilizing decorative elements as a vehicle to incorporate tangible interaction in domestic spaces. In an IKEA-like format, we designed a product catalogue of our own prototypes that illustrate the possibilities of the nearest future. These design illustrations should offer inspiration to those who wish to work with interactive materials (e.g. appearance-changing and soft-sensing), particularly in the context of interactive spaces. Through making, situating, and speculating, we show how designing interactive decor can be a promising area in Research-through-Design.

## Authors Keywords

Interior Design; Interactive Spaces; Art; Architecture.

## CSS Concepts

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• Human-centered computing~Human computer interaction (HCI);

## INTRODUCTION

Interior objects provide a unique opportunity to augment architectural spaces with technological capabilities that are integrated seamlessly. Building on our ‘Interioraction’ [14] design space, we present the conceptual term ‘Decoraction’ here to imply the merge of interior decoration with interaction design. The focus on decorative interior elements—that convey the space’s use, style and character—includes interactive wall paintings, lampshades, objets d’art, furniture, rugs, cushions and curtains, all of which can be both interactive and aesthetic. Such interactive decoratives, or ‘decoractives’, can utilize their affordances as a means of interaction. For example, a soft blanket throw is stroked, a cushion is plumped and a rug is stepped/sat on. Our research questions explore how such interaction can be realized using a range of interactive materials that have sensing and actuating properties (such as e-textiles, chromogenic pigments and shape-memory threads). This concept employs slow technology [18], adopts a parallel approach to the use of such materials in wearable technology, and intersects with recent aesthetic IoT devices, but employs pre-existing everyday objects.

Although decorative adornment and material qualities (such as surface finish, fabric texture, paint consistency, etc) are perceived to be prosaic features providing rich

potential for interactivity [11], research to date has not explored this fully [14]. Generally, physical interaction (either deliberate or implicit) [10,18] with interior objects has had limited study [14]. Despite the potential seen in some prototypes of interactive furniture [8,13,9], little attention is given towards the artistic values and style of their designs. Additionally, relevant work on soft interfaces and e-textiles has focused more on ‘fashion and wearables’ [6,21] and less on ‘interior design’.

As with Interior Design, Human-Building Interaction (HBI) [1] research supports the notion of regarding both the physical shape and the surface material of interfaces to be no mere superficial design feature sitting on top of the actual interaction, but essential to the generation of different meanings, experiences and expressiveness [3,12,20]. The decoraction concept emphasizes such qualities and shows below (in a product catalogue) how it can then be fully integrated into our ecosystem in non-disruptive ways. To do this we draw on a visual language inspired by Mobile Life and the Near Future Laboratory’s concept design of an “IKEA Catalogue from the Future” [5,16]. In doing this, we are trying to move beyond the ‘design workbook’ [7] or ‘annotated portfolio’ [4] approaches for detailed design process and insight. We utilize the common plot devices [2] of a well-understood format for presenting designs to emphasize placement, context and relative materiality of groups of artefacts. These are arguably, usefully inspirational qualities to support interactive interior design.

IKEA-like catalogue

well-understood format for presenting designs.  
Appropriate for interactive and shape-changing designs?

emphasize placement,  
context and materiality

presents achievable design fiction

will we see such designs in  
the near future?

Fig. 1  
The Decoraction  
catalogue



interactive  
decor with  
invisible tech  
raises many  
questions..

influence  
lived  
experiences?

family life  
patterns &  
rituals?

issues of  
control?

symbolism of  
spaces.. with  
elements of  
dynamism?

variation of  
surfaces/  
orientations

communicate  
together?

techless  
network?

and Bringing  
Decor into Action

Opportunities: wall painting, curtains, cushions, throws, rugs, vases, lamps, tiles.. what else?



Fig. 2 The Decoraction catalogue (page 1) showing WATERFALL, WATERDROP, DESPOT and TIKALIQ © Sara Nabil

### WATERFALL

This wall-art piece is a colour-changing painting that is made using thermochromic paint on a conventional painting canvas featuring 'water'. This dynamic wall-art changes the amount of visible water in the painting in response to the water consumption rate in the household. By accessing smart-meter online readings or uploading the meter reading into a mobile app, people can realize how much water is being consumed over time, not through numerical figures or even graph charts, but through multi-faceted aesthetics that is part of their interior decoration. This multi-faceted painting relies on an impressionistic approach that is better suited to interior aesthetic experiences.

### DESPOT

A lamp with spots painted on the shade's fabric with blue thermochromic paint that disappears with heat emitting from the light bulb over time. The more spots vanish from the lampshade, the more it raises occupants' awareness of their energy usage caused by the activated lamp over time. Also, DESPOT has hidden spots of magenta photochromic paint that only appear with direct sun-light (e.g. from an adjacent window) emphasizing the brilliance of sustainable energy and solar power, urging people to rely on natural instead of artificial lighting. In this sense, the DESPOT lampshade could go with any size-fitting floor-lamp or pendant.

### TIKALIQ

A shape-changing throw that actuates using SMA thin wire sewn to the inner layer of the fabric that contracts causing its furry texture to swirl in wavy motions as if it is alive. The malleability of the SMA does not affect the softness, affordance and texture of the throw which comes in pairs, where one is activated when the other is stroked, wirelessly through Wi-Fi. Stroke-sensing is detected using sewn conductive fabric inside. In this sense, friends or family members can send tactile pokes that would 'display' in the homes of their apart loved ones. This physical interaction could be perceived as being emotional and sincere more than 'mechanistic' devices or touch-screens GUI apps.

### WATERDROP

A matching partner to the WATERFALL painting and a soft version of it. In a white cotton background, the WATERDROP cushion features a single drop of water in various shades of blues (that also resembles our planet earth), plus some flying birds far away. Once WATERFALL activates, with the increase of water consumption, it sends a wireless signal to its sister cushion to activate as well, causing the (thermochromically-painted) water to begin slowly disappearing. For comfort, wires are eliminated, and thermochromic paint is heated by interwoven copper thread. Whilst they are matching, the cushion will still work simultaneously with the WATERFALL painting even in another room through Wi-Fi signal. Occupants can 'see' the change, and thus appreciate running water and become more self-conscious of their usage once the cushion birds are found with no water in their world.



Fig. 3 The Decoraction catalogue (page 2) showing CONVX and LITHER © Sara Nabil

### CONVX

CONVX is a shape-changing pouffe (i.e. a cushioned backless low seat) that has pressure-sensitive fabric layered underneath its top detecting load (of sitting, supporting feet, placing objects) and responding through a slow and gradual concaving on its side. CONVX uses SMA muscle springs to contract its concave-able side reflecting the pressure exerted on it over time. When objects on top are unloaded, CONVX pops-out again slowly and revert to its original round shape, reflecting -during that relaxing time- the history of carrying something over its back. One couldn't initially distinguish the interactive capabilities of CONVX with its stylish contemporary design and concealing all its technology inside its vivid mustard upholstery.

### LITHER

The LITHER rug is a shape-changing rug that responds to 'ambient sounds', specifically high pitches of loud voices or noises. Every time LITHER rug detects such a loud voice, it deforms as a whole (using SMA sewn underneath) then relaxes leaving behind small parts that are kept deformed. To un-deform the rug, one would have to physically manipulate it or control their noisy behaviour. LITHER also employs 'Slow Interaction' where over-time it deforms rather more and does not return entirely back to its default state if surrounding noises persist (e.g. a screaming parent, quarrelling couples, noisy children). Therefore, LITHER expresses aesthetic interaction, encourages self-awareness and imposes self-reflection on one's behaviour and attitude, not just instantaneously but over time as well.

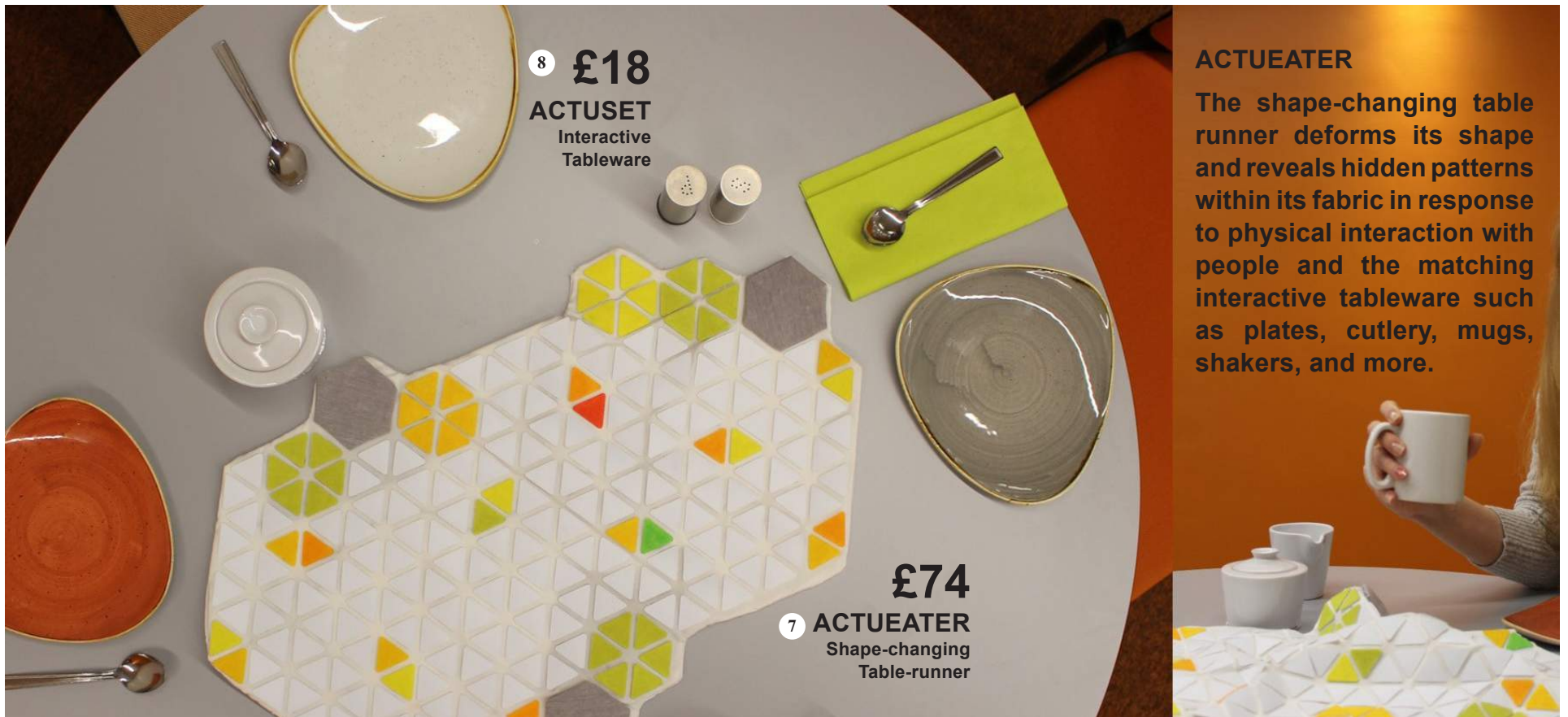


Fig. 4 The Decoraction catalogue (page 3) showing ACTUEATER and ACTUSET © Sara Nabil

### ACTUEATER

ActuEater [15] is an actuating table-runner that changes its shape by crumpling (through SMA thin springs stitched to the inner fabric) and changes its colour (of thermochromic fabric parts) in response to hand-touch and physical interaction with tableware. ActuEater detects interactions through thin capacitive sensing fabric (i.e. conductive knit fabric) sewn inside the table runner, together with matching ActuSet this collection creates a unique dining experience for people around them with a center-piece that they can engage with and through it with each other.

### ACTUSET

ActuSet is a set of matching tableware to the ActuEater that are either stainless steel (thus conductive) such as salt shakers and utensils, or porcelain painted with a conductive layer underneath such as matching plates, sugar pot, etc. Through the proximity sensing capability of the ActuEater's capacitive fabric, any conductive object passing over, or placed on top of, the runner causes it to crumple and reveal hidden patterns in its colour-changing fabric. Users can also paint the bottom of their own plates to enable them to be sensed by ActuEater in the same way.

### ACTUEATER

The shape-changing table runner deforms its shape and reveals hidden patterns within its fabric in response to physical interaction with people and the matching interactive tableware such as plates, cutlery, mugs, shakers, and more.

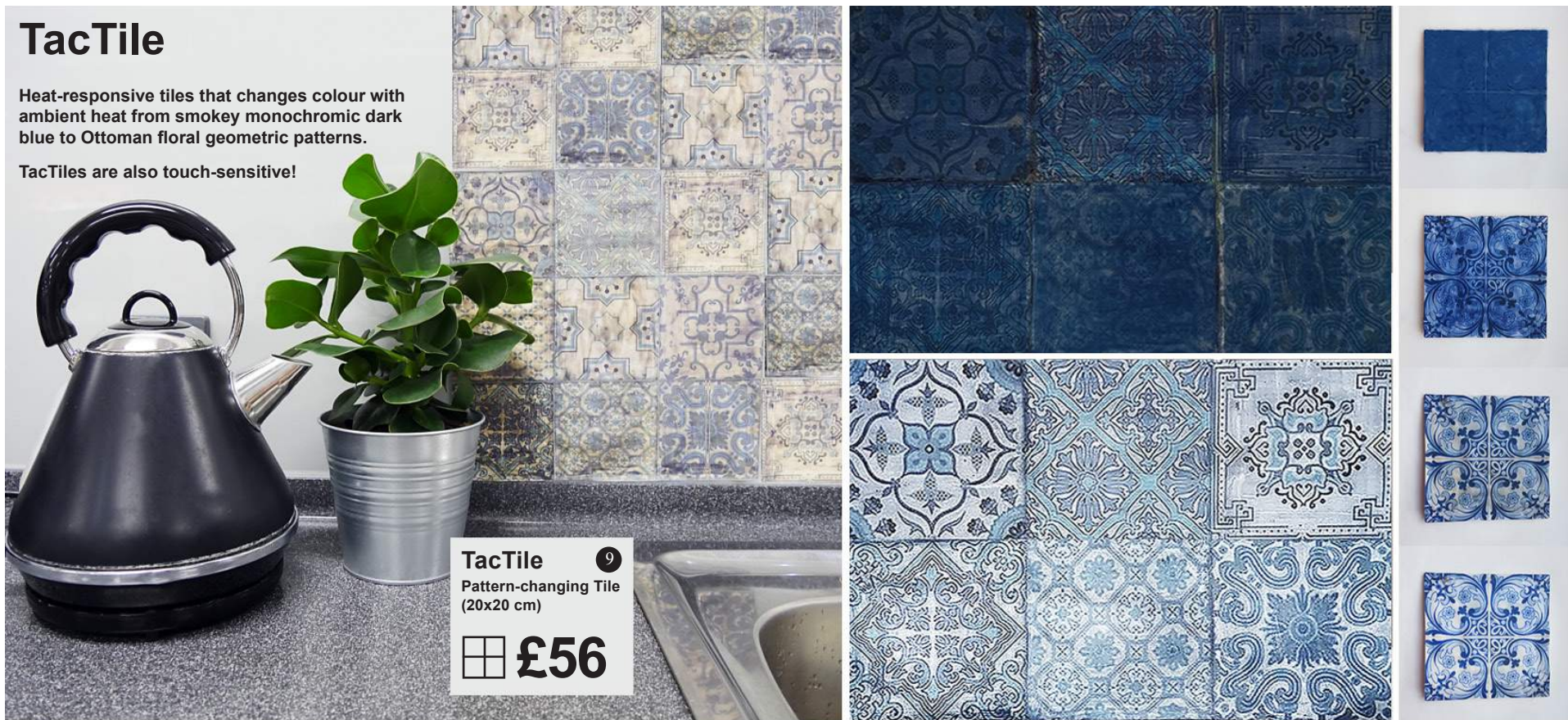


Fig. 5 The Decoraction catalogue (page 4) showing TACTILE © Sara Nabil

### TACTILE

The square-shaped tiles act as large buttons that users can activate one after another to turn on and off different patterns. Thus, people can play with the endless combinations of plain and patterned tiles on their walls. The unique texture of ceramic and its aesthetic appeal should also play an important role in the experiential effect of TacTiles. We imagine TacTiles deployed in the splashback of a kitchen, interacting in three different modes: 1) responding to touch, allowing users to play with its pattern and add a new eye-catching focal point every while; 2) responding to ambient heat while cooking, revealing the unseen and (often) unfelt smoke and heat; and 3) autonomously actuating changing its patterns over time for a dynamic environment.

### Making

The tiles are prototyped on laser-cut acrylic sheets that we designed in 10x10 cm pieces with an engraved path on the back to give space and depth for Nichrome wire. This design allows each separate tile to be individually controlled as desired and allows the flexibility of having other static tiles in the same design (if needed) reducing cost and effort. The pattern is then added on top for a traditional aesthetic look. Then, we painted the tiles' pattern with a layer of black and blue thermochromic paint. Finally, we connected the heating Nichrome to the Arduino microcontroller and programmed its software to respond to capacitive sensing by activating the Nichrome wire, that in turn causes the pattern change. However, this process takes a few minutes to heat and then to cool down again to be ready for another actuation. Still, the result is not only thermochromic-painted tiles that respond to ambient heat but electronically-controlled.



Fig. 6 The Decoraction catalogue (page 5) showing MORVAZ © Sara Nabil

## MORVAZ

To overcome the challenges of making a shape-changing vase, we used a layering solution. The idea was to have a glass container for the water and flowers, and another external façade that is malleable. Laminated cardboard material with an origami design is used for the exterior layer to give both an aesthetic design and flexible structure that can be manipulated. The interior body is fitted with Shape-Memory Alloy (SMA) spring, each attached between two anchors.

The shape of the vase can be altered from different sides at various angles, depending on the shape it was in last (martensite state) and on the overall bent origami form. The SMA springs are connected to an Arduino microcontroller that also has a proximity sensor connected to detect user interaction when (re)placing flowers or approaching its top opening. MORVAZ also enables hand manipulations to its flexible origami structure allowing people to actively change its physical shape as desired.

# STARA

These crystal beaded voile curtain swags are made of 'sensing' tassels fringe and actuating light voile fabric that creases itself when the fringe is 'touched'.

11  
**STARA**  
Sensing  
Actuating  
Curtain  
**£33**

STARA has an Arabic style, and an advanced seamless interaction, with no felt electronic components or wires. With sensing thread weaved in its fringe, and stitched muscle-springs, STARA gives you different looks with a finger touch.



Fig.7 The Decoraction catalogue (page 6) showing STARA © Sara Nabil

## STARA

With its tassels being sensors and its voile being the actuator, STARA demonstrates how technology can be seamlessly embedded in interior elements, even in the softest, most delicate, and traditionally-aesthetic materials. Conductive thread serves as both the sewing thread that attaches the fringe to the curtain and as the embedded sensing material at the same time. As we machine-sewed the conductive thread, we purposely pulled out extra thread from the bobbin at each tassel.

After sewing together, we used that extra thread pulled earlier to embed it inside the tassels using a sewing needle. Then used the needle to embed the end of the conductive thread to the sensor pins. For STARA, we used an Arduino microcontroller to program the SMA springs that pull the voile upwards based on touch and stroke-sensitivity of the tassels and fringe. As STARA hangs vertically, it relies on gravity to bring the SMA along with the voile back down.



## BEHIND THE CURTAINS (1 OF 3)

The crafting and making process of these artefacts is—in itself—research-led and knowledge-generating. As we prototyped each piece, we documented our Research-through Design (RtD) [24] process to build a pathway for exploring the potentials of this design space that have not been realized yet. Such design research is, therefore, the “articulation of this unfinished thinking” [22], giving the process of *critical making* [19] and reflection on the and ‘crafting’ of artful objects the ability to generate new knowledge and understanding.

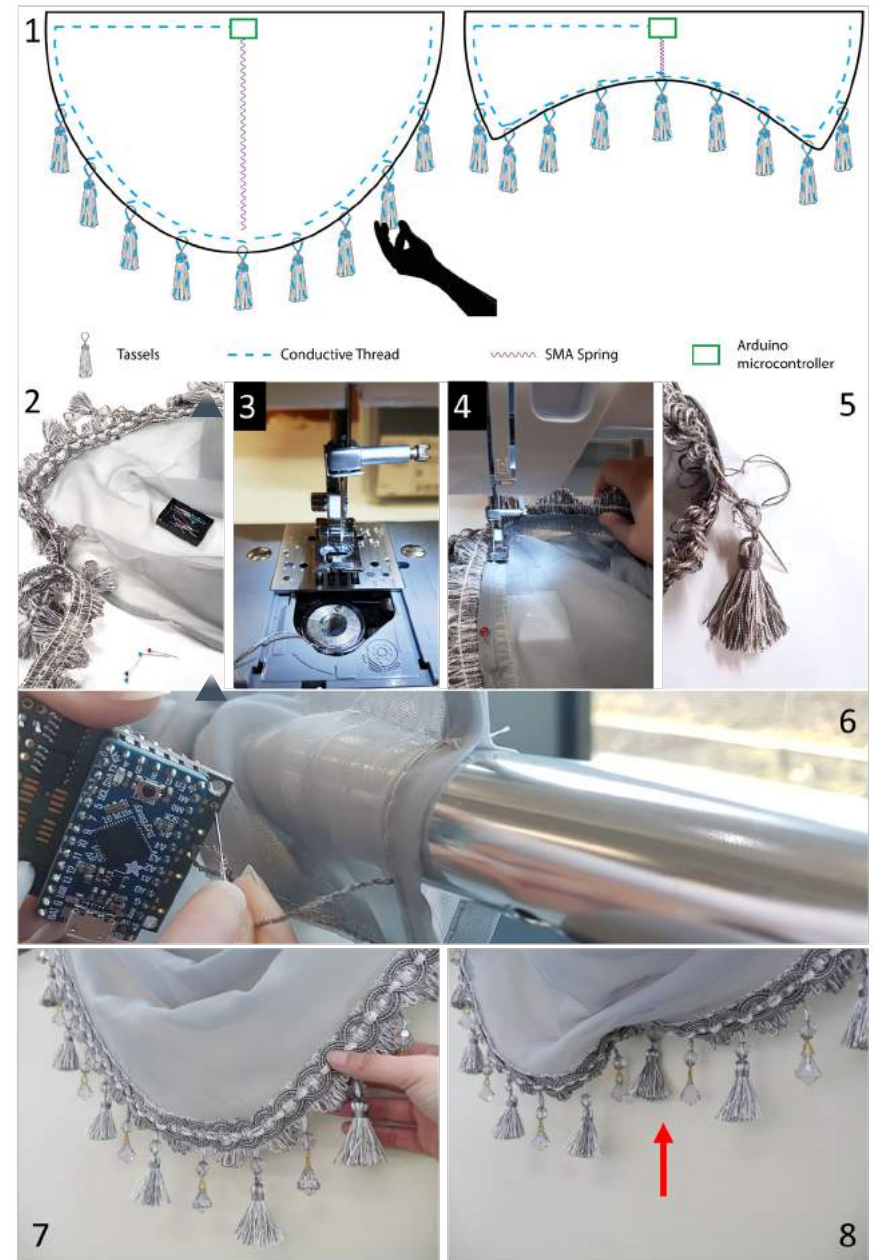
Fig. 8 TacTILE

Designing and crafting TacTiles: 1) digital design, 2) pattern design, 3) laser-cutting, 4) weaving Nichrome wire, and 5) programming.



Fig. 9 STARA

Crafting and making STARA: 1) Digital design; 2) Pinning the tasselled fringe to the fabric with pins; 3) Filling bobbin case with conductive thread; 4) Machine-sewing fringe to fabric; 5) Weaving conductive thread through the tassels; 6) Sewing conductive thread through the PCB input pins; 7) Programming tactile-sensing; and 8) Testing SMA actuation.



## BEHIND THE CURTAINS (2 OF 3)

A balanced blend between the roles of a thinker/finder and a tinkerer/maker requires tangibilizing some of the ideas and designs in situated studies through *critical engagement*, where material experience can be evaluated through use by people reflecting on their interaction [15].

Fig. 10 TIKALIQ

Furry Throw's making: 1) Designing the circuit; 2) Machine-sewing the fabric and the SMA; 3) inner body with relaxed SMA; 4) contracted SMA; and 5) Programming the slow, silent and subtle interactions.

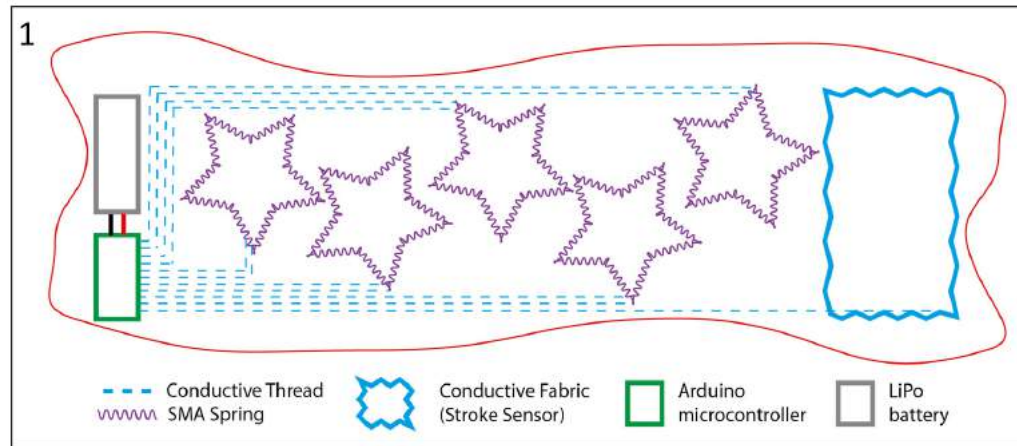
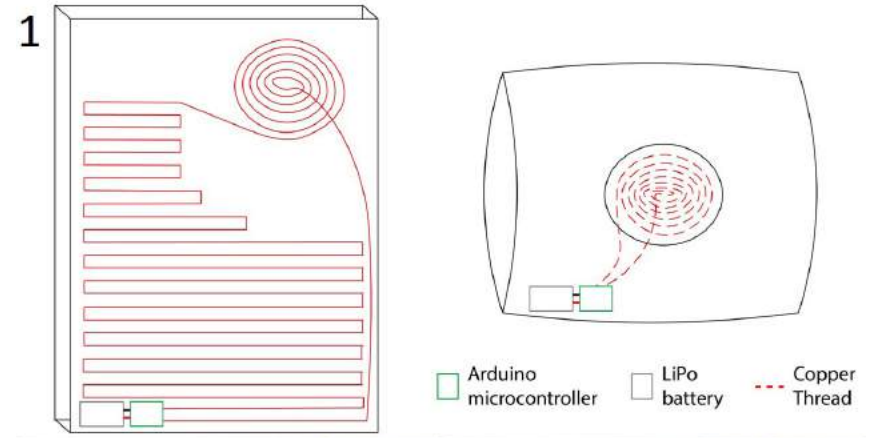


Fig. 11 WATERFALL and WATERDROP

1) Illustration of the design and circuit; 2) Crafting the WaterFall painting; and 3) The WaterDrop Cushion off (left) and on (right).



## BEHIND THE CURTAINS (3 OF 3)

To ease the tension between practicality versus imagination, we found refuge in alternative creative RtD methods that complement the other adopted approaches of critical making and critical engagement. On one hand, mimetic design of digital illustrations in the shape of a themed product catalogue is one way of tangibilizing future design ideas (that are proven to be valid and feasible) without the need to undergo all the making and deployment steps required for a situated study. On the other hand, diegetic fictional stories or vignettes are equally useful for exploring the play-of-possibilities in various (even hypothetical) scenarios avoiding causing any possible harm to users of situated studies. These methods of *critical speculation* that are framed in design fictions challenge both the utopian and dystopian futures [16] of our ideas and designs of decoration.

- ✓ learn from failures★
- ✓ change parameters★
- ✓ revisit design decisions★★
- ✓ open to refine concepts★★
- ✓ go beyond the obvious★★
- ✓ share visual accounts★★

## How can we design a shape-changing rug?

Motors are not practical.  
Can Shape-Memory Alloy (SMA) be sewn to deform it?

iterative  
experimentation,  
extensive trails,  
documentation,  
reflection and  
re-design

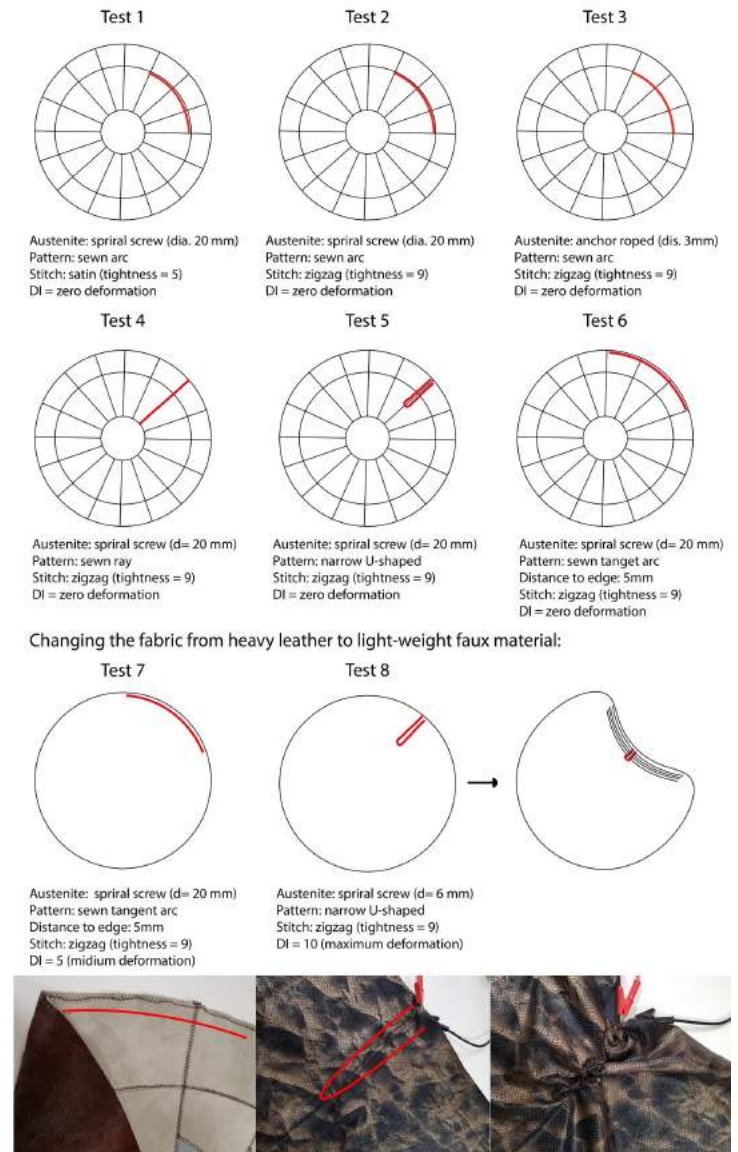
↓

design research★★

↓

scientific knowledge★

Fig. 12  
Making LITHER



## DISCUSSION

“How would we design interactive soft furnishing” is a question that involves deeper design research than common prototype development. The crafting of objects that we will sit or step on, lean towards, and pour water into requires considerations beyond making a wired gadget or rough proof-of-concept device. By exploring the set of design qualities of interior objects, we can envision their near-future versions, their materialities and their interactivities, in addition to the extended living experience entailed. Through RtD, we present an interplay of three methodological strands: critical making, critical engagement, and critical speculation.

The ideas we present in this catalogue are not specifying what should be made, but rather showing some possibilities, as exemplary decoratives presented to inspire design imagination. Moreover, our Decoraction Catalogue should not be thought of as a presentation of a futuristic vision (as in [16]), but rather an achievable reality of what we can do now with the technology to-hand, given that we have designed and built these interactive artefacts. Pages 2-8 show some pages of our catalogue presenting our 10 decoratives and their potential applications to inspire ideas while pages 9-11 show the backstage design process and the iteration often required over design decisions.

It is crucial to celebrate and learn from failures during this iterative design process and remain open to refining design concepts and design decisions. Presenting such design research in pictorial forms is particularly valuable as most of the thinking, polishing and developing of ideas take the form of visual accounts. One way of contextualizing interactive home elements is by placing them in the well-understood format of home decor catalogues. However, it not necessarily the ideal template in every case, particularly with shape-change, where various small alterations are meaningful in action but not quite clear in words or still photographs. We hope our research inspires designers to think of other form factors for interactivity at home, and we also hope that this example of documentation helps to continue the

design-research community debate around formats for documenting and presenting design research.

Moreover, there are questions raised for the design of interactive everyday things around us. If pillowcases are not just sensing us, but are communicating together, how would that influence our lived experience? If our homes become soft networks of ubiquitous invisible technology, or techless networks, how would that change near-future family practices and rituals?

Home decor that has the capabilities of longevity and temporal appearance-change can be beneficial e.g. changing forms, textures and colours from day to night or over the course of a year. However, we should also study how this would affect the symbolism of spaces where their decorative styles reflect the occupants’ identity and pride. Analytical and critical reflection of long-term in-situ studies of such decorative networks should shed light on other implications such as issues of control e.g., a couple and the interactive personalization of their sofa fabric. Another example is how interactive furnishing will leave traces of people’s presence in terms of self-reflection, self-expression and their privacy. Still, designing and studying interactive home decor can be a great opportunity for research around supporting social engagement, connection and togetherness.

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