Towards Textile User Interface Design Guidelines for Eyes-Free Use

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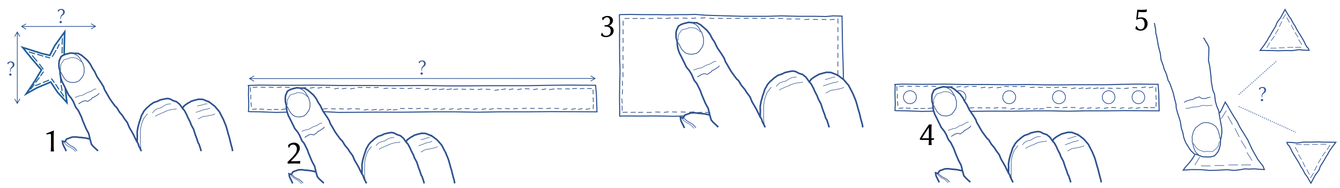

Figure 1: Our five experiments investigated size preferences for icons (1), sliders (2), the affordances of rectangles (3), when users perceived neighboring elements as belonging together (4), and their understanding of the orientation of non-horizontal interfaces (5). In most experiments, users worked eyes-free, using palpation.

Abstract

Due to their haptics, textile interfaces are promising UIs to control devices eyes-free, e.g., in darkness or when controls are placed out of sight, but there are few haptic design guidelines for such interfaces. Therefore, we conducted five experiments investigating the space and size requirements of such textile controls and how users understand the orientation of textile interfaces not placed horizontally in front of them. Our participants preferred symbols to be larger than the literature suggests, they preferred larger controls when interfaces were placed vertically next to them, and they memorized symbols from a world-centric perspective when they were out of sight. Using our findings, we identified future directions for follow-up research on design guidelines for textile interfaces.

CCS Concepts

• **Human-centered computing → Empirical studies in HCI**; **Haptic devices**; *Empirical studies in ubiquitous and mobile computing*.

Keywords

textile interfaces, design guidelines, eyes-free interaction, haptic interfaces

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1 Introduction

Textile interfaces are a promising approach to integrating digital controls into our homes. In furniture like sofas and cushions, they can be unobtrusive replacements for media and smart home remotes, matching the look and feel of the environment. Research about *fabricating* such controllers is extensive [16, 17, 19], and while such UIs are in view, existing visual design guidelines can ensure their intuitive use. However, to improve efficiency after users become familiar with these devices, when they use them in darkness, or when the UI is out of sight (e.g., on the side of an armchair), *eyes-free* use becomes important—and haptic design guidelines for this eyes-free use are still sparse. There is work on how the fabrication of UI components with different height profiles affects recognizability [18] or creates contrast [11]. Many fabrication parameters, however, still lack empirical investigation, in particular, space management on the surface and users' perception of UI orientation. We conducted five experiments to identify promising candidates for such guidelines. Four experiments investigate space requirements of textile UI components. For this, we built buttons, sliders, and trackpads with varying dimensions and investigated users' size preferences and what actions varying sizes and aspect ratios afford. We also studied when users group elements based on proximity. Experiment 5 examined how users interpret directional orientation when palpating shapes on a vertical surface. Our results can already help designers make textile interfaces easier to use, and they provide promising directions for larger-scale investigations.

2 Related Work

Smart fabrics and textile toolkits are an active research area. Conductive yarns can be manufactured on an industrial scale [17], and new fabrication processes increase textile sensor durability [16] or make smart materials more sustainable [21]. Numerous textile controls have been proposed, from menus and rocker switches [6, 20] to using conductive embroidered threads to detect users rolling fabric folds between their fingers for continuous input [8].

While much of the literature focuses on technical aspects of such fabrics, empirically derived design guidelines are sparse. A study of media controls on an apron [7] found, inter alia, that identifying controls must be quick, easy, and, at best, haptic; and that participants operating symmetric controls could not consistently map an action to one side but confused, e.g., 'next' and 'previous' buttons at first. Guidelines for haptic music notation recommend avoiding empty space and adding orientation points [2]. Haptic UIs for blind participants should add ridges forming a path to controls and frame the interface to avoid overshooting [1]. Well-known Gestalt Laws for grouping elements visually also apply haptically [4, 5]. Similarly, introducing a 'haptic vocabulary' is effective in creating natural mappings [12] between haptic controls and devices in a room [13].

In textile UIs, different element heights, forms, and textures can make elements stand out [11]. Pictorial galleries demonstrated what actions textile elements could afford and signify [9, 10]. Several studies have examined input and recognition efficiency for textile sliders and icons [14, 15, 18].

3 Study

Our study included 15 participants aged 20 to 31 (M: 23.38, SD: 3.58). Seven identified as female, eight as male. All studied or worked in computer science.

3.1 Setup

Fig. 2 shows our setup for all experiments. For Experiments 1, 3 and 4, which aimed to investigate haptic perception only, participants sat on the black chair behind a sight protection wall. Behind the wall, a piece of our fabric was glued onto the table as orientation for the samples' horizontal center. Behind that "homing fabric", several Velcro strips were glued onto the table to attach the samples. For Experiments 2 and 5, participants sat on the red chair, and we tested textile samples on a vertical, padded plate attached to the side of the chair.

3.2 Fabrication

We fabricated our textile samples following a procedure for textile icons optimized for haptic recognition [18]. However, we used thicker medium-density fiberboard (MDF) to make the shape edges more pronounced. For this, we glued 3 mm MDF cutouts onto the fabric for all raised elements and sewed another layer of fabric on top. We used a 100% polyester fabric (fine texture, 270 g/m^2). For recessed elements, we raised the surroundings instead. Fig. 3 shows our samples. For Exp. 2, we added copper foil separated into 23 parts beneath the slider (Fig. 3, right), which were connected to two MPR121 capacitance sensors to track finger movements.

3.3 Procedure

Originally, our study consisted of six experiments. We excluded one experiment as it did not fit the contribution of this work, leading to the five experiments described below. The order of experiments was counterbalanced using a Latin square. We explained each experiment in turn before it commenced.

3.4 Experiment 1: Preferable Icon Size

This experiment aimed to identify the most comfortable *icon size* for eyes-free recognition. While 13–20 mm icons have been tested and recommended for recognition in the literature [11, 18], we were interested in what size participants subjectively found preferable for recognition with mental demand and comfort in mind. For this, 4- or 5-point stars of increasing size were placed onto the two Velcro rows. We ensured participants fully palpated the complete icon by letting them count the spikes of the stars. Overall, each participant palpated ten stars sized from 13 mm to 67 mm in steps of 6 mm. 13 mm was selected from the literature [11], while 67 mm approximates the size of the palm. For each star, participants rated *comfort* on a scale from 1–5 (worst–best). After palpating all stars once, they reported their subjective *optimal size*. To prevent participants from recognizing the stars using the spike locations, the stars were rotated at random.

Results. Fig. 4 (left) shows average *comfort* ratings. The data shows a clear tendency towards 31 mm, which is also the average *optimal size* (M: 31.8 mm, SD: 12.8 mm). This is larger than typical icons in the literature. 67 mm was rated optimal once, 19 mm and 31 mm four times each, and 25, 37, and 43 mm twice each. A Friedman test revealed a significant effect of *size* on *comfort* ($\chi^2_9 = 70.41$, $p<0.001$). Pair-wise comparisons using Wilcoxon signed-rank tests (Holm corrected) showed 31 mm being significantly better rated than 61 and 67 mm ($p<0.05$ each).

3.5 Experiment 2: Comfortable Slider Length

This experiment examined subjectively preferred lengths for sliders in different orientations and positions. Sitting on the red chair, participants repeatedly swiped on a 30 cm slider, once to find the *maximum* comfortable finger movement range and once to determine *optimal* slider length. For this, we measured their *finger movements*. We varied *slider position* (side: vertical surface to the side of the strong hand, front: on a horizontal surface in front of the user) and *slider orientation* (horizontal, vertical).

Results. Fig. 4 (right) shows the results. We analyzed finger movements using a two-factor repeated measures ANOVA on our log-transformed data. The test revealed a significant effect of *slider position* (optimal: $F_1 = 5.38$, $p<.05$, maximum: $F_1 = 5.95$, $p<.05$) and *slider orientation* (optimal: $F_1 = 26.61$, $p<.001$, maximum: $F_1 = 22.51$, $p<.001$), but no interaction effects. Post-hoc pairwise t-tests (Holm-corrected) confirmed this. We found that vertical sliders have a decreased comfortable input range and should be remarkably smaller.

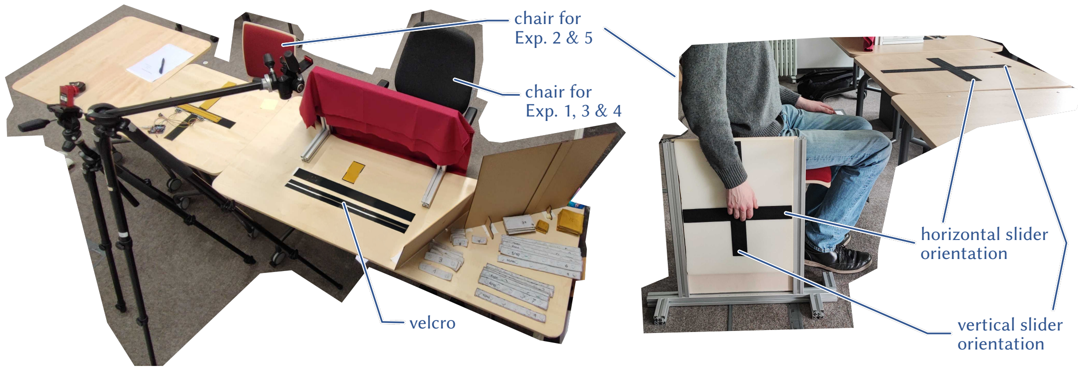

Figure 2: Setup: Except for Experiments 2 & 5 (comfortable slider length & conceptual orientation), participants sat on the black chair and performed tasks by putting their hand through the red curtain. Our samples were attached to the rows of black Velcro. For Experiments 2 & 5, participants sat on the red chair. If a vertical plane was needed, we placed the padded plate on the side of the red chair (right). This simulated reaching over the side of an armchair, for example.

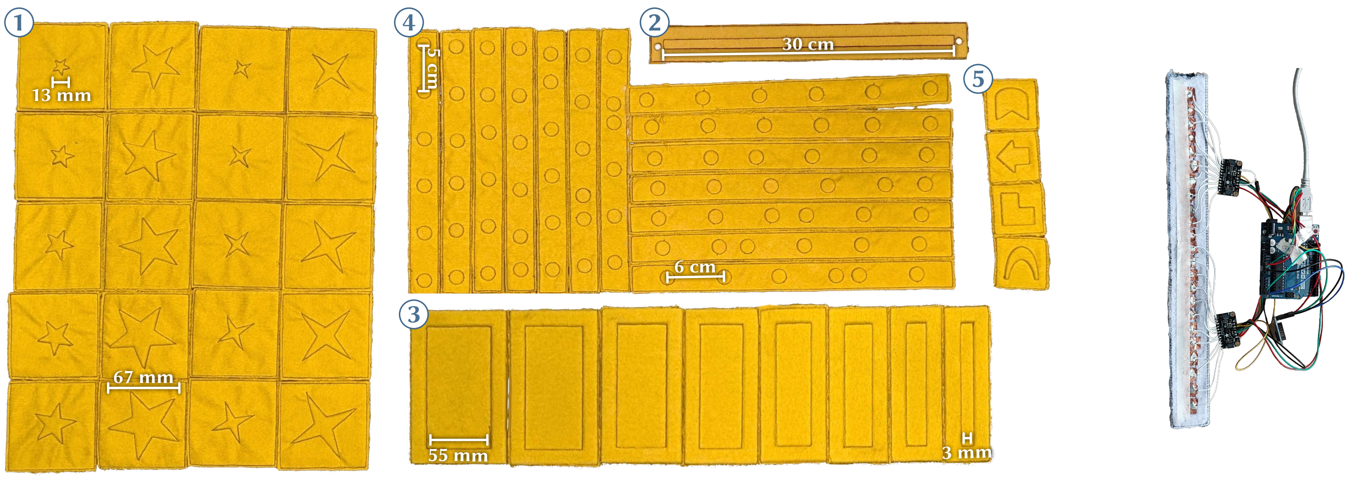

Figure 3: Sets of samples used, with their experiment number. (1) shows stars from 13–67 mm, (2) a 30 cm long recessed slider, (3) 10 cm wide rectangles with heights from 13–55 mm, (4) raised equidistant circles with one closer circle pair, and (5) four shapes participants should palpate first and draw afterwards. Right: The touch sensors attached beneath the 30 cm slider (2).

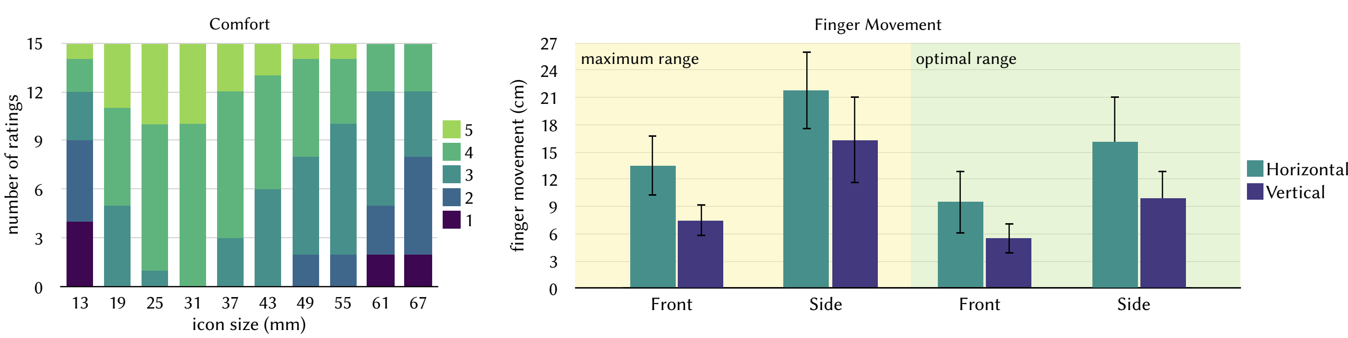

Figure 4: Left: Comfort ratings from 1–5 (worst–best) for each icon size palpated eyes-free in Experiment 1. Participants tended to prefer a size of 31 mm, larger than the literature suggests. Right: Maximum comfortable (yellow) and preferred (green) movement ranges from Experiment 2 dependent on slider orientation (horizontal or vertical) and interaction plane (in front or at the user's side). Whiskers denote standard deviations. Movement ranges are significantly larger with horizontal sliders and at the user's side.

As movement ranges increase when moving a UI to a vertical surface on the side of the user, scaling up the UI is recommendable to increase input resolution.

3.6 Experiment 3: Affordances of Rectangles

In the literature [e.g., 11], the affordance of rectangles is not fully determined. We wanted to investigate whether certain aspect ratios afford different actions like pushing, sliding, scribbling, or dragging. For this, participants palpated recessed rectangles, starting from an aspect ratio (height to width) of 13 mm:100 mm [14], and with height increasing in 6 mm increments up to 55 mm. Participants were tasked to palpate "elements of a textile user interface", describe their purpose, and how and, optionally, for what they would use it.

Results. Up to a ratio of 25:100, all participants identified the rectangle as a slider. With heights of 19, 25 and 31 mm, they started suggesting tapping (1, 2, and 1 time, respectively). 31–37 mm height was associated with sliders and trackpads; however, it was reported as unsuitable for both. From a ratio of 43:100 and up, most participants considered the shape a trackpad. When users recognized 13:100 and 19:100 as sliders, we also asked them which they preferred. While most answered 13 mm, 5 reported it as feeling too cramped—in particular for people with longer fingernails.

3.7 Experiment 4: Haptic Proximity-Based Grouping

Grouping using the Gestalt Law of Proximity also works haptically [3, 5]. However, it is unclear *how* close elements need to be for users to group them haptically without looking. To test this, participants palpated samples each containing a row of 13 mm circles. They were asked whether they could *detect* one pair of circles being closer to each other and how *confident* they were. If users perceived certain circles as closer, we asked if they considered them to be a *group*. Each sample consisted of 6 circles whose centers were all either 5 or 6 cm apart by default. We call this distance *standard distance*. In a row, we set an *irregular distance* between one random pair that was 40–90% of the *standard distance*. We also included three rows without any distance variations. We tested a *standard distance* of 5 cm first. The order of the samples was randomized. Participants did not know the number of unmodified samples.

Results. Participants were very successful in detecting closer pairs. We could not confirm any significant effects in our post-hoc analysis, although a deviation of 10% exhibited a tendency for being the hardest to detect. Although our *confidence* ratings were also not significantly different, the data suggests that confident difference recognition started with a distance of 70–80%. Participants started calling pairs a *group* when they were less than half the standard distance apart. We initially expected that users would determine a group by comparing the irregular pair to the others and, thus, in a relative relation. However, our participants tended to group elements earlier for the smaller *standard distance*. Therefore, we assume that for UIs using similar-sized elements, users may rather focus on absolute distances, for example, by referring to the width of a finger—something we observed frequently in our study.

3.8 Experiment 5: Conceptual Interface Orientation

Textile UIs could be deployed in new places, like the side of a sofa. However, it is unclear how users understand orientation in such situations [7]. We thus had participants palpate the four shapes in Fig. 3 (5) on a vertical surface eyes-free and draw each shape from memory. The shapes were designed not to suggest a bottom side and their initial orientation was randomly set to one of four sides. The order of shapes was counterbalanced.

Results. To record the orientation of the drawn icon, we used the perspective when standing in front of the interface, i.e., the perspective of the camera in Fig. 2 (right), as baseline orientation. We called this the *world-centric* perspective. If participants drew a shape as if leaning over the interface and watching from the top, we called this the *user-centric* perspective. 12 of 15 participants drew their icons only using one of those perspectives, although not always consistently. 7 participants drew shapes consistently from a world- (4) or user-centric perspective (3). If we consider one inconsistent drawing as mistake, 7 of 15 participants used a world-centric and 4 a user-centric perspective, which indicates a mostly consistent mental orientation of the interface.

4 Discussion, Future Work, and Conclusion

Often, textile UI shapes have been designed to be small but still recognizable [11, 15, 18]. In contrast, in Exp. 1, our participants preferred larger shapes, peaking at around 31 mm. Therefore, we recommend repeating this experiment with other shapes to verify this size first and then repeating shape recognition studies to see how much recognition improves then. Larger icons also allow for testing more feature-rich shapes than in previous studies.

While slider sizes in [14] matched our movement range for frontal horizontal use, future studies should explore varying slider orientations to create a more generalized model due to the changed movement range when turning the sliders sideways. Compared to [11], we found fewer suggestions to tap a 13 mm high rectangle. This may be because their rectangle imitates a physical button better by using recessed outlines. However, their sample was shorter, with a 13:64 aspect ratio, close to our 19:100 rectangle that also received the first suggestions to get tapped. We recommend an aspect ratio between 13:100 and 19:100, with a height of 19 mm also catering to users with long fingernails. Surprisingly, the ratios calculated from the vertical and horizontal comfortable finger movements for frontal use in Exp. 2 are close to 55:100—the size of our largest rectangle, which indicates its suitability for textile trackpads. Moreover, based on our results of Exp. 2, we recommend considering multiple surfaces for future research on human input capabilities since input ranges can vary significantly—in our case, by several centimeters.

In Exp. 4, we initially assumed that participants would perceive elements as being grouped by relative, not absolute distances, similar to our visual grouping patterns. While we observed that after halving the distance, more than half of the participants grouped the circles together, the differences between the standard distances show a tendency for participants to use *absolute* distance when grouping elements eyes-free. We believe this is because we are,

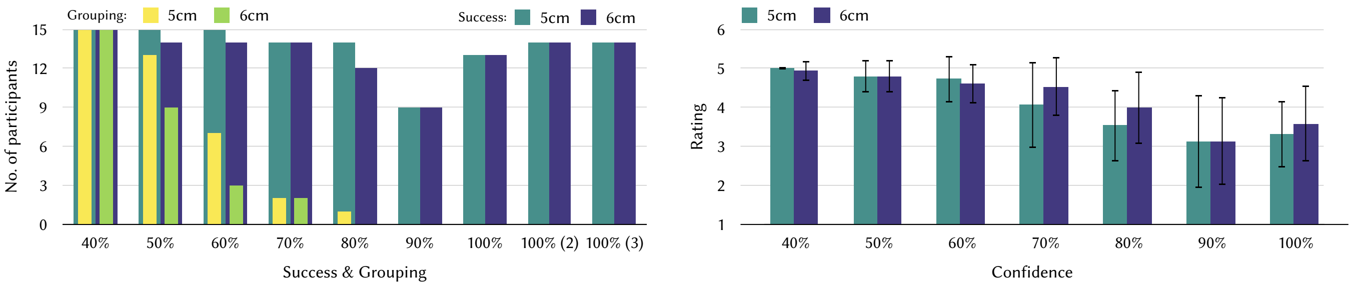

Figure 5: Results of Experiment 4. Left: Number of participants successfully recognizing if there was a pair with different distances (teal and blue) and interpreting such pairs as groups (yellow and green). The x axis shows the distance of the closer pair relative to the standard distance between items. 100% refers to the samples without a closer pair. Columns with parentheses show the results for the corresponding repetition. Right: Confidence ratings for successful recognitions. Whiskers denote standard deviations. To group elements, participants seemed to use absolute distance rather than comparison with adjacent distances.

haptically, limited to sensing what is directly under our fingers, while, visually, we can see the complete arrangement at once. Nevertheless, we assume that the grouping mechanism can gradually shift to relative comparisons when the standard distance increases, which should be investigated in future experiments.

Experiment 5 clearly showed that UI orientation is important. While 7 of 15 participants had a tendency toward a world-centric perspective of the interface, our number of participants was too small to claim a clear trend confidently. This should be further investigated considering additional factors such as other shapes—in particular shapes suggesting a clear 'down' like a house—, other base surface orientations, and shape locations. Furthermore, we may observe clearer tendencies when multiple shapes come together.

Overall, we investigated the space and size requirements and how users understand the orientation of textile UIs. These experiments are a work in progress and thus come with some shortcomings: While we intentionally performed smaller-scale experiments to identify salient directions for follow-up research, each experiment was only able to study a small, although hopefully indicative, set of concrete cases. Furthermore, some of our experiments held the (increasing) order of elements constant so that we could more consistently observe tipping points throughout our participants—e.g., when comfort ratings decreased again after 31 mm. While learning and order effects should be considered in future iterations, we do not expect experiment results to deviate significantly from our findings when using different orders of treatments. In particular, we believe that the results of Exp. 1–3 can already be used to build good textile interfaces. We hope that this work provides helpful contributions to the HCI community, encourages discussions, and helps guide follow-up work.

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References

[1] David Arnim, Benito S. Piuzzi, Chang S. Nam, and Donghun Chung. 2007. Guidelines for the Development and Improvement of Universal Access Systems for Blind Students. In *Universal Acess in Human Computer Interaction. Coping with Diversity*, Constantine Stephanidis (Ed.). Springer Berlin Heidelberg, Berlin, Heidelberg, 603–612.

[2] Ben P. Challis and Alistair D.N. Edwards. 2001. Design principles for tactile interaction. In *Haptic Human-Computer Interaction*, Stephen Brewster and Roderick Murray-Smith (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 17–24.

[3] Dempsey Chang, Keith Nesbitt, and Kevin Wilkins. 2007. The gestalt principles of similarity and proximity apply to both the haptic and visual grouping of elements. *Copyright* 64 (01 2007).

[4] Dempsey Chang and Keith V. Nesbitt. 2006. Identifying Commonly-Used Gestalt Principles as a Design Framework for Multi-Sensory Displays. *2006 IEEE International Conference on Systems, Man and Cybernetics* 3 (2006), 2452–2457. https://api.semanticscholar.org/CorpusID:9001248

[5] Alberto Gallace and Charles Spence. 2011. To what extent do Gestalt grouping principles influence tactile perception? *Psychological bulletin* 137, 4 (2011), 538.

[6] Scott Gilliland, Nicholas Komor, Thad Starner, and Clint Zeagler. 2010. The Textile Interface Swatchbook: Creating Graphical User Interface-like Widgets with Conductive Embroidery. In *International Symposium on Wearable Computers (ISWC) 2010*. IEEE, Seoul, Korea (South), 1–8. doi:10.1109/ISWC.2010.5665876

[7] Paul Holleis, Albrecht Schmidt, Susanna Paasovaara, Arto Puikkonen, and Jonna Häkkilä. 2008. Evaluating Capacitive Touch Input on Clothes. In *Proceedings of the 10th International Conference on Human Computer Interaction with Mobile Devices and Services* (Amsterdam, The Netherlands) *(MobileHCI '08)*. Association for Computing Machinery, New York, NY, USA, 81–90. doi:10.1145/1409240.1409250

[8] Thorsten Karrer, Moritz Wittenhagen, Leonhard Lichtschlag, Florian Heller, and Jan Borchers. 2011. Pinstripe: Eyes-Free Continuous Input on Interactive Clothing. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. Association for Computing Machinery, New York, NY, USA, 1313–1322. https://doi.org/10.1145/1978942.1979137

[9] Sara Mlakar, Mira Alida Haberfellner, Hans-Christian Jetter, and Michael Haller. 2021. Exploring Affordances of Surface Gestures on Textile User Interfaces. In *Proceedings of the 2021 ACM Designing Interactive Systems Conference* (Virtual Event, USA) *(DIS '21)*. Association for Computing Machinery, New York, NY, USA, 1159–1170. doi:10.1145/3461778.3462139

[10] Sara Mlakar, Mira A. Haberfellner, and Kathrin Probst. 2025. Signifiers in Textile-Specific Interaction Design. In *Proceedings of the Nineteenth International Conference on Tangible, Embedded, and Embodied Interaction* (Bordeaux, France) *(TEI '25)*. Association for Computing Machinery, New York, NY, USA, Article 47, 14 pages. doi:10.1145/3689050.3704431

[11] Sara Mlakar and Michael Haller. 2020. Design Investigation of Embroidered Interactive Elements on Non-Wearable Textile Interfaces. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–10. doi:10.1145/3313831.3376692

[12] Donald Arthur Norman. 2013. *The Design of Everyday Things: Revised and Expanded Edition* (2nd ed.). Basic Books, New York.

[13] Oliver Nowak, Lennart Becker, Sebastian Valentin Pettirsch, and Jan Borchers. 2024. Mappings in the Home: Selecting Home Appliances in 3D Space. In *Extended Abstracts of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, USA) *(CHI EA '24)*. Association for Computing Machinery, New York,

NY, USA, Article 237, 7 pages. doi:10.1145/3613905.3650745

[14] Oliver Nowak, René Schäfer, Anke Brocker, Philipp Wacker, and Jan Borchers. 2022. Shaping Textile Sliders: An Evaluation of Form Factors and Tick Marks for Textile Sliders. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 214, 14 pages. doi:10.1145/3491102.3517473

[15] Oliver Nowak, René Schäfer, Elisabeth Jane Buttkus, Lea Emilia Schirp, Heiko Müller, and Jan Borchers. 2025. Investigating Eyes-Free Recognition and Distinguishability of Textile Icons in Pairs. In *Proceedings of the Nineteenth International Conference on Tangible, Embedded, and Embodied Interaction* (Bordeaux, France) *(TEI '25)*. Association for Computing Machinery, New York, NY, USA, Article 22, 13 pages. doi:10.1145/3689050.3704931

[16] Yuecheng Peng, Danchang Yan, Haotian Chen, Yue Yang, Ye Tao, Weitao Song, Lingyun Sun, and Guanyun Wang. 2024. IntelliTex: Fabricating Low-cost and Washable Functional Textiles using A Double-coating Process. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 859, 18 pages. doi:10.1145/3613904.3642759

[17] Ivan Poupyrev, Nan-Wei Gong, Shiho Fukuhara, Mustafa Emre Karagozler, Carsten Schwesig, and Karen E. Robinson. 2016. Project Jacquard: Interactive Digital Textiles at Scale. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 4216–4227. doi:10.1145/2858036.2858176

[18] René Schäfer, Oliver Nowak, Lovis Bero Suchmann, Sören Schröder, and Jan Borchers. 2023. What's That Shape? Investigating Eyes-Free Recognition of Textile Icons. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 580, 12 pages. doi:10.1145/3544548.3580920

[19] Tony Wu, Shiho Fukuhara, Nicholas Gillian, Kishore Sundara-Rajan, and Ivan Poupyrev. 2020. ZebraSense: A Double-Sided Textile Touch Sensor for Smart Clothing. In *Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology* (Virtual Event, USA) *(UIST '20)*. Association for Computing Machinery, New York, NY, USA, 662–674. doi:10.1145/3379337.3415886

[20] Clint Zeagler, Scott Gilliland, Halley Profita, and Thad Starner. 2012. Textile Interfaces: Embroidered Jog-Wheel, Beaded Tilt Sensor, Twisted Pair Ribbon, and Sound Sequins. In *Proceedings of the 2012 16th Annual International Symposium on Wearable Computers (ISWC) (ISWC '12)*. IEEE Computer Society, USA, 60–63. doi:10.1109/ISWC.2012.29

[21] Jingwen Zhu, Lily Winagle, and Hsin-Liu (Cindy) Kao. 2024. EcoThreads: Prototyping Biodegradable E-textiles Through Thread-based Fabrication. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 857, 17 pages. doi:10.1145/3613904.3642718