The Sound of Textile: An Interactive Tactile-Sonic Installation

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ABSTRACT

The Sound of Textile installation consists of seven interactive textile stripes enhanced with sensing capabilities. The expressive textile textures invite visitors to touch them. Every established connection between the visitor and the textile triggers a specific sound serving as an invitation into the imaginative world of stories and emotions. The selection of textiles and sounds has been established from collecting associations that arose in the authors when moving our fingers over specific textures. This introspective journey is the artistic counterpart to our HCI development of smart textiles, concerned with enhancing textiles with sensing capabilities, as well as finding ways to communicate interaction possibilities within the medium. The installation, therefore, serves as an intense sensory experience for the user, but also provides valuable insights on how we could design more meaningful interactions with smart textiles in future applications.

CCS CONCEPTS

• **Human-centered computing** → Interaction design; Interaction design process and methods; Interface design prototyping.

KEYWORDS

Smart textiles, Installation, Tactile, Texture, Sonic, Interaction

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1 INTRODUCTION

User interfaces on smart textiles open the door for more rewarding sensory interactions than the current flat screen surfaces we use in our everyday lives. Smart textiles appeal to our visual as well as our haptic perception and have the potential to be one of the more seamless ways users can interact with new technology [5].

Textiles enhanced with sensing capabilities can detect the users' physical gestures on the textile material and produce responses as a result. Within our HCI research group, we focus on exploring ways to functionalize textiles, recognizing input signals through different sensing methods, and defining characteristics that communicate interaction to the user. In our artistic research we explore the different emotional and associative responses users might have to textures, and how those could affect the gestures they perform and the interaction results they would expect.

The Sound of Textile installation, as seen in Figure 1, is a combination of both aspects: our knowledge as developers of smart textiles, and our artistic desire to collect texture associations and translate them into sound.

2 IDEATION

The core question of this project was exploring the effect of textile textures on our imagination, perception, emotion, and possibly even behavior. We found a parallel between our goal and the goal of color psychology in its application within design [2], where e.g. the color blue might be associated with stability, knowledge, and trust, and is often seen as the primary color in brand identities for banks and investment companies. Could something similar be said e.g., for a

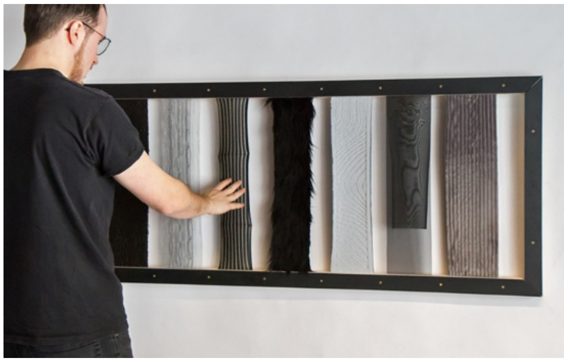

Figure 1: The Sound of Textile is an interactive installation displaying seven stripes of textiles, that trigger different sonic outputs when approached, touched, and stroked.

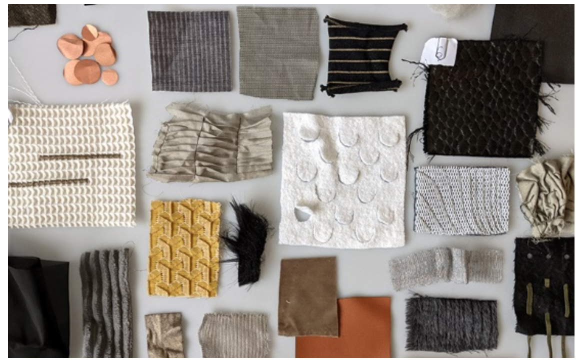

Figure 2: Textile samples for the material selection process.

smooth texture? *Tactile color* [4], a project by Lois Lawrie aimed to translate the color wheel theory and contrast systems into a set of tactile patterns. Etzi at.al [1] mapped the associations and emotional states we have, to everyday materials through non-words and adjectives. A correlation between the underlying physical properties and "anything that is associated with the subjects' imagination" has been researched in various materials [8, 10].

Artistic concept: Our artistic aim was to apply these concepts to textiles. Interactivity as a central aspect of our work demanded an adequate response of the installation to physical contact. Just as touch can provoke visceral emotional responses, sound can yield a similar reaction. The synonymous use of the term texture for both physical surfaces and the tonal quality of sounds offered us a clear path of how to transfer the haptic sensation to another realm of sensory stimuli. The collected associations to textures were to be used when selecting the final textiles, as well as to create a bridge between these textiles and their sonic representations.

Material selection: Our material exploration began by collecting a vast variety of different textile samples, as seen in Figure 2. Some were chosen for their intriguing natural texture characteristics, while others were further manipulated either by heat, cutting, bonding, embroidery, etc. Specifically, we were searching for examples in all material categories as discussed by Okamoto [7]. In their paper, the authors found five potential dimensions as *fine roughness* (rough/smooth), *macro roughness* (uneven/relief), *hardness* (hard/soft), *warmness* (warm/cold), and *friction* (sticky/slippery). These dimensions could, for example, be used to evoke a cheerful emotional response to a perceived shiny surface, making a person more likely to touch this texture when compared to e.g. a rough or spikey texture.

The authors of this installation, therefore, started with individually observing which are the responses they feel and the adjectives they would use to describe the feeling of touching specific textiles in the collection. Although the adjectives that were associated with the textiles varied heavily between individuals, there were some commonalities. One textile was described as feeling *bubbly, like boiling a cup of tea*, and another as feeling *soft and cuddly, like a cat's fur*. The final seven textiles we chose, were the ones that either shared similar associations for more than one person or were unique, but interesting and expressive enough to draw the interest of others as well (e.g., a texture that felt *rough, like medieval chainmail* or one that felt *uneasy, like sea waves after a storm*).

3 IMPLEMENTATION

Functionalizing textiles: To make the textile samples interactive, we enhanced them with self-capacitive sensing detecting proximity and touch. By making textiles conductive we enabled them to store electric energy. Through the proximity of our skin, we can then disturb their electric field. We added external electronics that measure this change in capacitance and trigger varying sounds based on which textile sample the visitor is interacting with, and how close to the surface they are. As tactile properties of textiles are the most important part of this installation, we had to be careful to add electronic sensing as subtly as possible. We employed several approaches to achieve that. In-situ polymerization [3] is a chemical process of integrating piezo-resistive properties at the material level, preserving a textile's haptic and mechanical characteristics. This process was used in *Topographie Digitale* [9], another interactive installation that reacted to the touching and stroking of the pleated textile. We used polymerization on two of our textile samples to make them conductive. Three textiles were enhanced by adding conductive yarns. One of these three textiles was embroidered with a conductive yarn Madeira 40, another was made conductive by hiding sewing lines of Amman SilverTech 120 conductive thread into the texture, and the third textile used full integration into the fabric by knitting the Madeira 40 conductive yarn. The remaining two textile samples were bought conductive from their manufacturers, one was a copper wire mesh from LessEMF, and the other a woven fabric of carbonized yarn produced by Sefar.

Sound: Sound took on the role of interaction output in our installation. We chose to use the same associations collected from the material selection process and recreate them through sound. All the sound clips were generated in Abelton Live 10 and were either slightly manipulated field recordings of e.g., water boiling or a cat purring, which can be recognized by the visitors very instinctively. Or were created from scratch within the program as personal reflections of a provided association e.g., the Flutter Ambiance effect was used for sea waves after the storm. These remained more open to the imagination and interpretation of each visitor.

4 THE SOUND OF TEXTILE INSTALLATION

All presented aspects were finally combined into an interactive installation titled *The Sound of Textile,* and ready to present in real time and space.

Interaction: The interaction between our installation and the visitor is based on Norman's fundamental design principles [6] primarily focusing on *perceived affordances.* They communicate the properties of an object or surface which can help viewers determine possible (inter)actions. The contact between installation and visitor is what triggers *feedback*, in our case an audio output. Every textile sample has a correlating sound composition. But each composition also changes and develops based on how each person is touching the textile. The *mapping* is based on the distance between skin and textile, and results in all individual audio outputs transitioning through a range of different sounds, usually developing from subtle to more intense.

Hardware and software: Each individual sensor is measured capacitively using a Cypress PSoC4 development kit. In combination with the comparatively large sensor sizes, we can detect different touch intensities and hovering at varying distances. The measurement results are forwarded to a PC for further processing. The resulting conditioned data is sent via the MIDI protocol to the music production software Ableton Live running on the same machine. This midi input determines which audio samples are played and therefore the resulting sound composition.

5 IMPRESSIONS

Questioning whether people share some similarities between what they feel through their fingers to what they associate with that feeling, motivated us to invite a few people to interact with our installation (cf. Figure 3) and discuss their impressions. For most visitors, sounds were inseparably intertwined with the textures and tactile sensations. We noticed they rarely talked about one without the other. They interacted either as explorers and systematically stroked each textile individually, or as creators combining sounds in sonic landscapes, where the textiles only served as triggers.

Most people found the tactile-sonic connections "really funny", a few displayed confused reactions, and one person jokingly noted it as "disturbing". We were very pleased to hear how they described their experiences, e.g. "I heard wind and water, it made me feel like I am on a walk [in nature]." Although one person did mention a mismatch "It doesn't feel like [it sounds].", most people described the experience as very positive: "It's fun!", "Now I want to make a song with this." Reflecting the visitor attitudes, the installation acted as a tactile-sonic mirror and consequently seemed either shy or temperamental, gregarious or introvert, chaotic or calm, depending on who was interacting and how.

6 CONCLUSION

As observers of art pieces, we are rarely openly invited to touch surfaces, encouraged to consciously bring our tactile sensations into the front of our awareness, and inspired to think about possible meanings behind what we perceive through our fingers. Therefore, the installation proved to be a rich and immersive experience for all the visitors, as well as a source of valuable information for the artists. A possible future of this project would be extending the grid-like layout into an even more immersive structure that could potentially allow viewers to interact with other parts of their bodies as well. We see a big prospect in exploring this design space much further and would like the installation to also serve as an invitation to all users, designers, engineers, makers, artists, and other possible collaborators with the hope of creating more usable and pleasant textile user interfaces of the future.

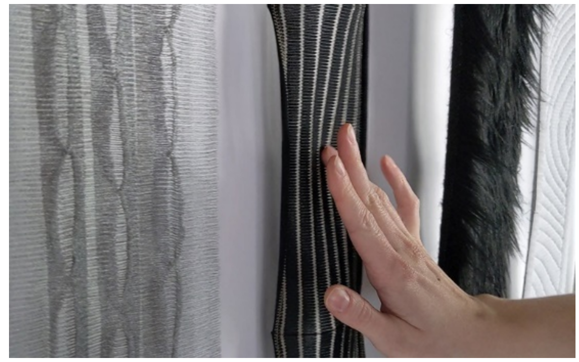

Figure 3: A close-up of interaction between a visitor and the installation.

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