Musical Skin

Fabric Interface for Expressive Music Control

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ABSTRACT

We demonstrate a soft, malleable fabric contoller. Attendees can use it to explore sounds, collaboratively create soundscapes and music. This soft input device - Musical Skin - senses where it is touched and how much pressure is exerted on it. This is done using a method consisting entirely of fabric components. Using this textile matrix sensor, the performer's role is changed from that of manipulating a rigid device to engaging with a malleable material. The sensor pushes the performer to explore how the motion of their body map to the sound, changing not only the performers experience but also engaging the audience beyond what typical electronic musical input devices would. In this extended abstract, we discuss the sensing mechanism and describe the installation we envision the musical skin to be used in.

CCS CONCEPTS

• **Human-centered computing** → *User interface toolkits* ; • **Applied computing** → *Sound and music computing* ; *Media arts* ;

KEYWORDS

Tangible Interfaces, Embodied Interaction, Musical Interface, e-Textile, Soft Circuits, On-Body Interaction

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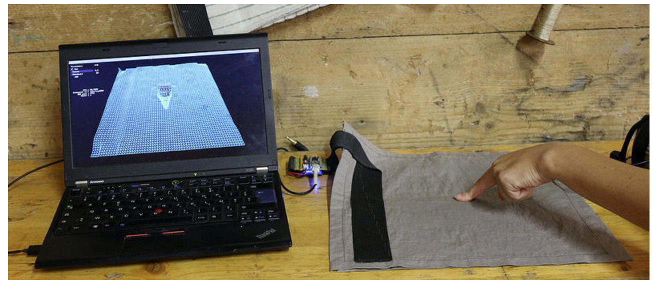

Figure 1: Visualization of the Musical Skin being touched.

1 INTRODUCTION

We present an installation using Musical Skins: fabric interfaces that users can freely manipulate to play music [2]. If draped over the body, interesting feedback modalities emerge. The users feel the tactile properties of the fabric in their fingertips, while at the same time feeling the pressure and taps of the fingers through their body. Additionally percussive hits, tones and pads fill the room with sound, leading to a multisensory experience involving the entire body. This fabric sensor is hand made (see figure 2), and designed for musical expression and aesthetics, explicitly opting for a playfull approach to technology over devices that turn us into productivity machines. Musical Skins can take on different roles, such as a drum kit to create distinct beats and one-shot sounds by tapping it, or a lead instrument to play modulated melodies on it, or polyphonic device for exploring harmonies, and soundscapes. Different instruments will be accessible to the visitors during the exhibit. As the sensor is very robust, no special training or instruction is required for participants.

2 RELATED WORK

Electronic textiles have recently received a significant amount of attention with project Jacquard, however e-textiles and soft circuitry have a much longer history. For example, Joanna Berzowska presented e-textile fashion in 2004 [1], her dresses retained a 'memory' of intimate experiences of the wearer. Hannah Perner Wilson published an overview of soft fabric sensors in 2009 [5] and along with Mika Satomi, they maintain an archive of electronic textile experimentations [1]. Similar resistive sensing solutions to ours are used as rapid-prototyping methods. Some of these methods have been documented by David Holman [4]. We use a layering technique demonstrated by Rachel Freire [3]. Our musical skins add additional expressive modalities over typical keyed input devices. This has also been explored by others, such as Seabord [2], Linnstrument [3] or Lambdoma [4].

3 IMPLEMENTATION

This textile sensor was designed with open source, collaborative and DIY development in mind (see figure 2). The hardware and software designs are freely available and documented at http://eTextile.org.

3.1 Hardware

3.1.1 Textiles. The sensor consists of a grid of vertical and horizontal conductive textile strips (see figure 3), separated by a piezo-electric fabric. When the material is touched, the piezoelectrical

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[1] http://kobakant.at/DIY
[2] http://www.needforkeys.com/blog/the-seaboard-grand-redefining-the-keyboard
[3] http://www.rogerlinndesign.com/linnstrument.html
[4] http://www.lambdoma.com/keyboard.php

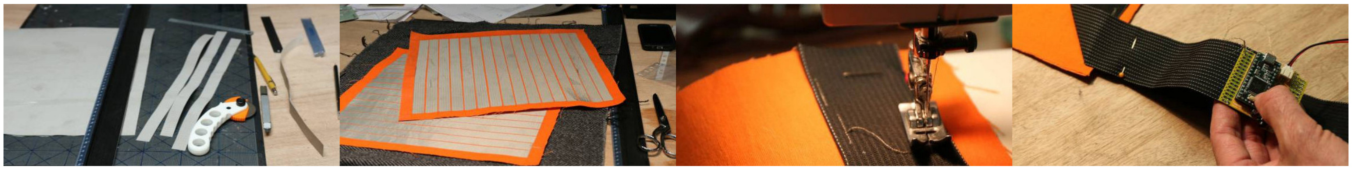

Figure 2: Steps to create the conductive layers and connect them to the microcontroller.

material is compressed, decreasing its resistance. The conductive fabric used is made by Stratex [5] but there are more affordable alternatives available. The piezoresistive textile used for now is made by Eeonyx [6] and has a resistance of 20K ohms per square. While the material is relatively expensive, it allows for detailed measurement range and a fairly good power consumption compared to other available resistive materials such as Velostat [7].

3.1.2 Electronics. A simple voltage divider allows measuring this resistance, but we need a matrix to measure all the possible pressure points. This is done by sequentially pulling each power line high, and measured the voltage by column, in a nested loop. Figure 3 shows an overview of how a 4 x 4 variable resistor matrix is connected (note that our system has a 16 x 16 resolution).

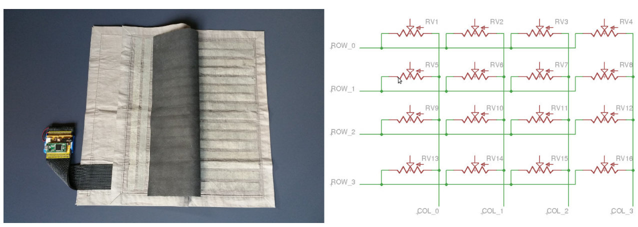

Figure 3: Left: the vertical and horizontal stripes of conductive fabric, and the resistive fabric in the middle (dark grey). Right: Illustration of a part of the variable "resistor" matrix.

3.2 Software

3.2.1 Microcontroller. We use a Teensy 3.X [8] to sample the voltages of the sensor. The noise floor is subtracted and the data is normalized, then sent as packets to a computer. Additionally, we use the analog output of the Teensy to allow generating audio without a computer (the board embeds everything needed to work on rechargeable battery).

3.2.2 Computer. When connected to a computer, the data is processed by a program made with OpenFrameworks.cc. We use blob detection algorithms from OpenCV.org to detect the size and locations of touch points. To improve the blob detection, we interpolate the data from 16 x 16 to 64 x 64. As we get a continuous pressure measure, this interpolation improves the resulting touch localization. Each blob's center and pressure level is then sent to other applications using the OSC protocol. This enables the Musical Skin to control music applications [9] or interactive visualizations as will be demonstrated during the exhibition.

[5]http://statex.de
[6]http://eeonyx.com
[7]http://www.lessemf.com/plastic.html
[8]http://pjrc.com/teensy

4 DEMO

The installation can be adopted to the constraints and opportunities of the space available to us. Visitors will discover that different instruments require different input behavior. The soft malleable nature of the controller allows for interesting explorations not possible with conventional interfaces [2]. For example, while a single touch typically would trigger a single sound or drum hit, if the instrument is folded, visitors can create custom polyphonic soundscapes. Finally, this music controller allows to use our bodies - or the bodies of others - as instruments: we can amplify body percussion with additional sounds, or we can hug each other to create soundscapes. As such expressive on-body input is novel, we believe that our demonstration will provide visitors with a valuable opportunity to improve their intuitive understanding of such technologies.

5 CONCLUSION

We propose an installation consisting of Musical Skins which can be used by visitors to control the environment in the form of adapting sound. The primary intent of the fabric instruments is for collaboratively making music while exploring shapes, materiality and bodies. This can be done by draping the fabric over objects, folding and deforming the fabric, or wearing it on the body. The e-textile itself is open source and improves over similar sensing applications both in terms of robustness and resolution.

6 ACKNOWLEDGMENT

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[9]Available on http://github.com/eTextile/Skins