Musical Skin

Fabric Interface for Expressive Music Control

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ABSTRACT

We present our work about a soft, malleable fabric instrument. Attendees can use it to explore sounds, collaboratively create soundscapes and music. Our soft instrument - 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 our textile matrix sensor, the electronic performer role is changed from that of rotating knobs, to an embodied enactment of music. 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 musical input devices would. In this extended abstract, we discuss the sensing mechanism and describe the installation we envision our 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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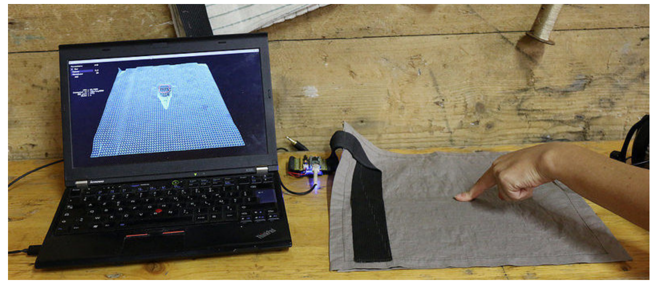

Figure 1: Visualization of the Musical Skin being touched.

1 INTRODUCTION

We present an installation using Musical Skins: fabric interfaces that users can freely manipulate to play music. 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. Our fabric sensor is hand made (see fig. 2), and designed for musical expression, opposing a view of ubiquitous computing that turns us into productivity machines. Musical Skins can play different roles, a drum kit to create distinct beats and one-shot sounds by tapping it, a lead instrument to play modulated melodies on it, or for harmonics, enabling the exploration of different chords and soundscapes. Different instruments will be accessible to all visitors during the exhibit. As the sensor is very robust, no special training or instruction is required for participants.

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2 RELATED WORK

Electronic textiles have recently received a significant amount of attention with project Jacquard [6], 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 has since expanded on that work [4]. 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 [2, 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 fig. 2). The hardware and software designs are freely available and documented at [URL temporary hidden for anonymization].

3.1 Hardware

3.1.1 Textiles. The sensor consists of a grid of vertical and horizontal conductive textile strips (see fig. 3), separated by a piezoelectric fabric. When the material is touched, the piezoelectrical material is compressed, decreasing its resistance. The conductive

[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

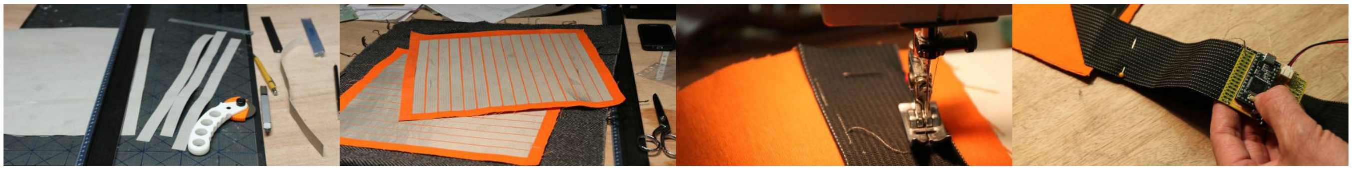

Figure 2: Steps to create the conductive layers and connect them to the microcontroller.

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 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).

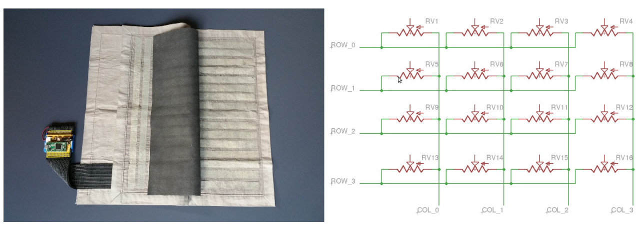

Figure 3: Left: the vertical and horizontal stripes of conductive fabric, and the resistive fabric in the middle (dark grey). Right: Illustration of a part of the variable "resistor" matrix for 3d pressure sensing.

3.2 Software

3.2.1 Microcontroller. We use a Teensy 3.x[8] to sample the voltages of the sensor. The measured voltages are converted and sent as data packets to a computer. Additionally, we use the analog output of the Teensy to allow generating audio without a computer.

3.2.2 Computer. When connected to a computer, the data is processed by a program made with open frameworks[9]. We use blob detection algorithms from OpenCV[10] 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, but as we get a continuous pressure measure, the interpolation improves the resulting touch localization too. Each blob's centroid and pressure level is then sent to other applications using the OSC protocol. This enables the Musical Skin to control a music applications 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
[9] http://openframeworks.cc
[10] http://opencv.org

4 DEMO

The installation can be adopted to the constraints and opportunities of the space available to us. Visitors will discover that different instruments have different sound qualities. The soft malleable nature of the instruments allows for interesting explorations not possible with conventional interfaces. 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, our instruments allows us to use our bodies (or others') as instruments: we can amplify body percussion with additional sounds, or we can hug each other to create soundscapes. This type of expressive on-body input is something that we have very little experience with and this will allow visitors to improve their intuitive understanding of such potential technologies.

5 CONCLUSION

We suggest an installation consisting of the soft fabric instrument 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. We are submitting this installation both because we because we believe it will be an engaging experience for people interested in the topics of MOCO.

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