SillyTone Squish Factory

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ABSTRACT

This paper describes the SillyTone Squish Factory, a haptically engaging musical interface. It contains the motivation behind the device's development, a description of the interface, various mappings of the interface to musical applications, details of its construction, and the requirements to demo the interface.

Keywords

Performance, design, kinesthetic, gesture, haptic, children, flexible, anthropomorphic.

1. INTRODUCTION

Too often computer music interfaces suffer from a lack of viscerality; users may find the connection between the gestural input and the synthetic output to be tenuous or unintuitive. This disconnect between input and output leaves the user with a sense of artificiality – they fail to connect with the music they are producing. Several studies have sought to bridge this gap through the introduction of various haptic feedback techniques, including vibration and motorized resistance [1,2]. Alternately, the SillyTone Squish Factory generates haptic response through the physical construction of the interface, using the resistance inherent in the materials used to generate feedback. Other devices, such as the Sonic Banana [3], have used similar techniques, relying on the elastic qualities of the construction materials to generate resistance, leading to a more satisfying user experience.

Whereas traditional instruments are for the most part constrained to relatively quantized input strategies – i.e. valves are either open or closed, keys are either struck or not (with notable exceptions, of course) – the elasticity of controllers like the SillyTone Squish Factory affords a continuous range of sensitivity, like a trombone with a multidimensional range of motion. The intuitive nature of this type of design makes these controllers especially appealing to children and novice musicians. This phenomenon is being researched, most notably at the MIT Media Labs, which has been conducting research on "HyperInstruments" such as Maggie Orth's and Gili Weingberg's Music Shapers, malleable balls with embedded sensors [4]. The challenge lies in maintaining this intuitive affinity while allowing enough refinement of control for use by more sophisticated musicians.

2. IMPLEMENTATION

The underlying structure of the device consists of four force sensitive resistors (FSRs), arranged in a 2x2 grid, for each of the two handles. Each FSR is anchored to a movable divot. Attached to each divot is a length of tensile polyurethane filament, which is threaded through holes in a stationary platform and anchored to the base of a dowel. The dowel is secured into a cavity in the outer silicone shell. When the handle is manipulated, the dowel pulls the filament, which in turn pulls the divots up against the stationary platform. This puts pressure on the FSRs, which generates the signal. Depending on the direction the dowel is pushed, different FSRs will be triggered to different degrees. By simultaneously analyzing the signal from all eight FSRs, a high level of precision can be achieved in detecting the manipulation of the handles. One of the advantages of this setup is that it allows for not only a full range of motion in the horizontal plane, but can also detect changes in the vertical, allowing users to generate a signal by pulling up on the handles. This extra range of motion was part of the motivation for choosing the FSR implementation over a more traditional joystick interface.

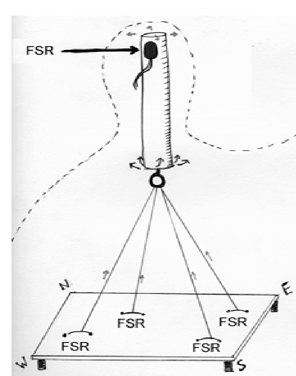

Figure 1. Diagram of internal structure. FSRs mounted below stationary platform.

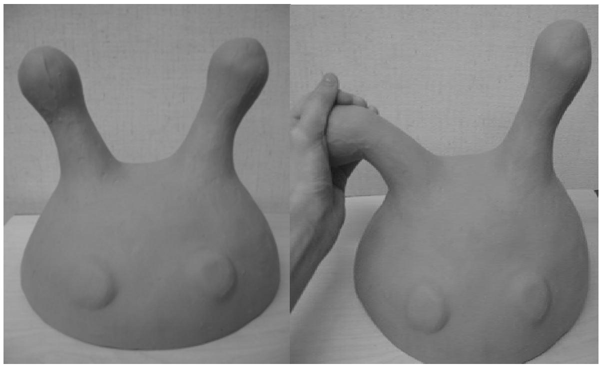

Figure 2. The SillyTone Squish Factory at rest and while being manipulated

In addition, there is an FSR mounted towards the top of each of the two dowels. These register in response to squeezing, a natural impulse when gripping the flexible silicone handles. The inclusion of these FSRs was crucial to the overall design, which emphasizes response to users' natural impulses, thereby creating intuitive controls.

Towards the base of the device are two simple buttons. These are not visible on the surface of the device. Rather, they are suggested by the presence of two imminently "pushable" mounds in the silicone shell. Two LEDs are connected, lighting up when the corresponding button is pushed.

The shell itself is composed of a blue silicone polymer. It is approximately one inch thick, a dimension settled upon after experimenting with the relative rigidity of several thicknesses. The shell provides both support and resistance, holding up the dowels as well as providing force feedback as the user pushes, pulls, twists, and squeezes the handles. The overall shape is anthropomorphic and approachable, encouraging children and novice users who might be intimidated by more complex looking instruments.

3. MAPPING

The signals generated by the left and right handles are processed separately, with the buttons allowing users to cycle through several modalities. The left handle is designated as a note generator, and may cycle between two modes – Note Selector and Arpeggiator. The former allows the user to select between eight different notes corresponding to the major scale by moving the handle in the eight cardinal and secondary directions in the horizontal plane. The Arpeggiator consists of an oscillator being sent five different note values at a rate of one every 200 milliseconds.

While the left handle generates notes, the right processes them. One mode filters the signal through four different effects: ring modulation, harmonization, frequency shifting, and chorus, or a combination of the above if the handle is pulled in a diagonal direction, proportional to how close the handle is to the effect's respective orientation. There is also a Spacialization mode, allows the user to control the orientation of the sound in eight channels. The user may also select a clean (effect free) mode. Alternately, the user may set the right handle to note selector as well, thereby controlling two separate sound sources at once.

The two FSRs mounted at the top of the handles control the amplitude of the signal. Squeezing a handle will increase the amplitude of a signal generator, or the wetness of a signal filter.

All of the readings are sent to an external microprocessor where they are calibrated. Using Open Sound Control, the values are then sent to a Linux machine running PureData (PD). Several PD patches run in tandem, interpreting the input with regards to the selected module.

4. FUTURE

Future work on the device will focus on increasing robustness and expanding the available modules. Currently, a mode allowing for the real time processing of external input, like a voice or instrumentalist, is being developed. Work is being done to streamline the PD patches, thus reducing the device's reliance on heavy processing power. Refinement of the casing and display will further enhance the user's experience. Eventually, the processing should be completely self-contained, making the SillyTone Squish Factory viable as a stand-alone musical instrument.

5. DEMO REQUIREMENTS

Ideally, the device would be set up in a room with 8-channel capabilities. Also, since approachability and tactile sensation are such integral facets of the design, spectators should be invited to use the device themselves.

6. ACKNOWLEGEMENTS

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