
MusicFabrik: A Playable, Portable Speaker

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Abstract

In this work-in-progress we introduce our prototype, a portable speaker augmented to be used as an electronic music sketchpad which allows musicians to play, record and compose multi-track music on the fly. We developed the MusicFabrik cover for the portable speaker, a playable textile cover which, although in functional sketch stage now, shows promise of becoming a useful tool for impromptu loop creation and collaborative music playing. We present our initial user encounters of the sketch. See video: <https://youtu.be/pe2QaYv1Imo>.

Author Keywords

Musical Sketchpad; New Interfaces for Musical Expression; Meaningful Interaction with Smart Devices; Augmented Portable Speaker; Sound and Music Computing; Musical Interaction.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction

In this work in progress, the aim is to explore how we can take a relatively new everyday object, the portable speaker and augment its functionality to include an electronic music sketchpad, allowing anyone musically

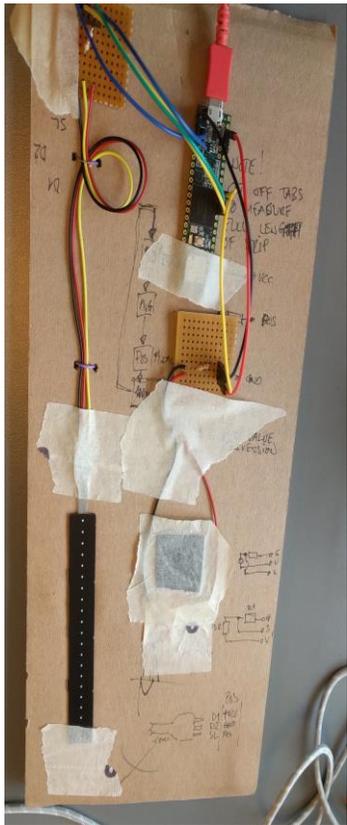


Figure 1 – The first cardboard exploration of pressure sensors and interaction. Image stretched for zoom.

inclined to play, record and compose multi-track music without the need for a computer. It emerges from a curiosity around bringing together two domains: the portable speaker, now nearly ubiquitous in homes, and instruments/music production tools providing the ability to express oneself by creating music. We look to refashion the passive consumption of recorded music into a more interactive experience by changing the role of portable speakers.

For the sake of this work, we are looking to musicians who are interested in creating loops of music, recording these, and even playing collaboratively, on a whim and we target the portable loudspeaker as a platform for this musical sketchpad due to its potential for marketability.

Method

We utilize a research through design method [1] wherein we refer to our early mockup of a functional system as a sketch [2], and gain insight from both the process of developing the sketch and the interactions with users.

Related Works

Electronic music sketch pads exist in many different forms already in the world today such as the KaossPad by Korg¹. We describe how certain elements of such sketch pads inspire our design in this work. However, to the best of our knowledge there is nothing commercially available combining a portable speaker with such sketchpad concepts (at the time of writing).

¹ http://www.korg.com/us/products/dj/kaoss_pad_quad/

One concept which we have been inspired by is the use of hexagonal grid keyboard layouts for musical notes. The hexagonal grid affords the user three degrees of close relationships between directly adjacent notes. Commercially available examples include Snyderphonics Instruments², C-Thru Music³, Starr Labs⁴, and Cortex Design⁵, some of which are based on historical examples (accordions have been built since the 19th century using various isomorphic keyboards).

We found this interesting for our design, as it positions discrete notes on the hexagonal grid in such a way as to allow musical constructs (chords, intervals, melodies, etc.) to take on the same shape regardless of the tone. This musical isomorphism has been shown to have advantages in learning [5], composition [6] and performance [3].

More straightforward interaction designs for musical sketchpads include products such as Teenage Engineering's OP1⁶ or ROLI's blocks⁷. These tend to use looping as the interaction style; a wide array of both hardware and software looping stations exist today. Academic research into this areas includes projects such as the Musical Navigatrics [7], or the reacTable [4]. However, as with the commercially available products, these projects tend to primarily be

² <https://snyderphonics.com/>

³ <http://c-thru-music.com/>

⁴ <http://www.starrlabs.com/>

⁵ <https://www.cortex-design.com>

⁶ <https://www.teenageengineering.com/products/op-1>

⁷ <https://roli.com/>



Figure 2: First on-speaker explorations of what it might be like to play on the speaker itself.



Figure 3: Connecting the speaker to the BeagleBone Black and a Bela and then to a keyboard.

controllers, and do not combine a high-quality speaker into the design of the interface itself.

Interface

To keep the look and feel of the speaker intact, we explored having fabric buttons as part of the (removable) cover of the speaker. We developed an interface which can function either while attached or detached from the speaker. We used Eeontex fabric⁸ connected to individual analog inputs on a PJRC Teensy along with Interlink Force Sensitive Linear Potentiometer sensors to determine the capabilities of the Eeontex fabric. Both the button and the fader are force sensitive and have proved to be precise in reaction to interaction.

The hexagonal grid as a keyboard layout

The aim of the uncommon layout is to simplify the learning process and improve the playing experience. After examining the pros and cons of the several different keyboards' layouts, we decided to introduce in our project a Wicki-Hayden based keyboard. The keyboard is composed of several hexagons and its layout is isomorphic since any given musical pattern (scale, chord etc.) has the same shape independently of the starting pitch. This permits having a certain conformity between the hand's position on the keys and the sound that this particular position produces.

The keyboard should be playable both while attached to speaker or removed, so three different layouts were created. Two of these were based on the Wicki-Hayden layout but modified. One of these were only slightly modified, while the other was a hybrid between a

⁸ <https://www.sparkfun.com/products/14110>

Wicki-Hayden layout and a matrix of 4 by 5 square pads where each pad represents a chord. The third layout was based on a modified version of the classic piano layout.

Hardware

To develop a functional prototype, we used a BeagleBone Black (low-power, single-board computer) connected to a Bela⁹ expansion board. After connecting the line-out of the Bela to the line-in on our speaker, we connected a MPR121-based breakout board and capacitive sensors to the Bela and using a C++ sketch provided by the developers of Bela we were able to produce sounds when the capacitive sensors were activated. The pitch of the sound depended on which sensor was activated. We then attached the sensors to the speaker using tape to explore what on-speaker interaction might be like.

Software

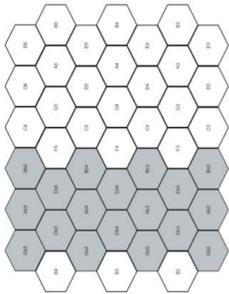
To further explore how we might play different samples dependent on sensor activation, we looked into the SoundFont synthesis specification¹⁰, which allows audio samples and sound effect parameters to be stored in a single file allowing a software synthesizer to produce a high-quality instrument sound. There are many royalty-free SoundFont files available online with high-quality instrument soundbanks. We used the open-source TinySoundFont (TSF) C/C++ library¹¹ to load SF2

⁹ <https://github.com/BelaPlatform/Bela/blob/master/examples/06-Sensors/capacitive-touch/render.cpp>

¹⁰ <https://en.wikipedia.org/wiki/SoundFont> & <http://freepats.zenvoid.org/sf2/sfspec24.pdf>

¹¹ <https://github.com/schellingb/TinySoundFont>

The keyboard layout on the speaker cover:



-	m7	B	G	D#
+	m	A#	F#	D
SUS4	Maj7	A	F	C#
SUS2	7	G#	E	C



Figure 4 – The Wicki-Hayden layout combined with a matrix of chords and controls.

SoundFont files to memory and synthesize the final audio output using the BeagleBone/Bela.

Initial User Encounters

To gain insights into how musicians might use the speaker, we took the sketch to the three users. We used the protocol by Wu and Bryan-Kinns [8] as they were working with a new musical interface and designed their procedure to allow for experimentation and exploration of the interface through a three session setup: introduction, interaction with a prototype and interview. Our participants were people with at least some experience with creating electronic music and who had used a loop device/feature before.

The main purpose of the user encounters was to gather feedback on specific fundamental elements of the sketch:

- Determine usability of the looping function: How was it to use this for looping music?
- Will users prefer to play music directly on the speaker (on the MusicFabrik cover), or will they prefer to take the cover off?
- Which use case scenarios do the participants see?

The three participants found the looping function both fun and useful. One participant suggested that the keys could be placed in two different sides of the speaker to be able to play with both hands. Another participant enjoyed using the sensors on the speaker for playing drum sounds because he found the touch sensor of the speaker more responsive. When asked whether they preferred to play directly on the speaker or take the MusicFabrik cover off and place it on the table; one

participant preferred to place the cover on the table because it felt more natural, like a traditional keyboard, the two other participants stated that it depends on the situation. If a flat and sturdy surface is available they would place the cover on that, however, if not, they would prefer to play directly on the speaker. One participant suggested a use case for playing directly on the speaker could be taking the speaker with the cover on it to the park and sitting in the grass while working on new music ideas.

Participants agreed the hybrid keyboard with both pads and a small version of the Wicki-Hayden would be the easiest to play on the keyboard by people with little musical experience. Two participants preferred the piano-like keyboard as a controller when unwrapped, while the third found the hybrid one to be a better solution for them. The two participants with less experience in playing piano found the layout of the Wicki-Hayden keyboard interesting, and expressed their interest in playing it without knowing the actual advantages of this layout.

Conclusion

We presented an augmented portable speaker designed to include an interactive electronic music sketchpad, allowing anyone musically inclined to play, record and compose multi-track music without the need for a computer. We explored our sketch with three users who provided feedback on the interactive looping functionality, the concept of a playable MusicFabrik cover wherein the portable speaker's cover is playable (on or off the device), and the concept of collaborative play. We found that each of these areas is interesting to continue working with in future research.

Future Work

The results of the user test show promise for continued development of a custom MIDI controller attached to the speaker. Specifically the modified version of the Wicki-Hayden layout concept with an additional square pad area for playing preset chords and drum sounds received high marks among the testers. Our next software and hardware milestones include making the looper more robust and optimizing the SoundFont synthesizer library in order to avoid buffer underruns. In order to fit the sound processing hardware inside the speaker, it would be useful to research the feasibility of combining the recently released Pocket Beagle¹² with a smaller custom version of the Bela expansion board. A future prototype would also incorporate all the hardware into a removable cover for the speaker. Further development on the hardware including PCB design is required for this. We will explore these options in our next prototype iteration.

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¹² <https://beagleboard.org/pocket>