

# Grain Prism: Hieroglyphic Interface for Granular Sampling

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## ABSTRACT

This paper introduces the Grain Prism, a hybrid musical instrument that combines granular synthesis and live audio recordings. Presented in a capacitive touch interface, users are invited to create experimental sound textures with their own recordings. The interface's touch plates are introduced within a series of obscure glyphs, instigating the player to decipher the hidden sonic messages. This way, the mysterious interface opens space to aleatoricism in the act of conjuring sound, and therefore the discovery of "happy accidents" in making electronic music.

## Author Keywords

Granular sampler, Explorative interaction, Capacitive touch interfaces

## CCS Concepts

•**Hardware** → *PCB design and layout; Tactile and hand-based interfaces*; •**General and reference** → *Design*;

## 1. INTRODUCTION

March 1968, Toronto, Marcel Duchamp and John Cage sat by a chess table to make music [4]. The two legends, in an unusual collaboration, have augmented a chess board with sensors and electronics to trigger sounds from every individual action during their match. This event entered history as a new take on experimental music making that incorporated randomness. The experimental music of the Dada movement was an early stage of the contemporary concept of aleatoric music, and influenced numerous experimental musicians of that era, including John Cage [6]. Following Dadaism, the *Musique Concrète* movement, initiated by Pierre Schaffer in the 1940's, would use fragments of sound to create new compositions. Sounds recorded from various sources are spliced and combined to create a more complex structure, making it harder to trace back the original sound. *Musique Concrète* pushes musicians to step out of traditional ways of composing. With no predetermined structure, the sounds are first recorded, then afterwards freely manipulated and processed by the composer [8].

The Grain Prism is inspired by these two movements. It allows the player to record and manipulate audio samples, and seed a digital granular synthesis patch. The pyra-



Figure 1: An early prototype of the grain prism instrument.

mid shaped object does not resemble traditional table-top electronic music instruments or controllers. By abstracting away mechanical buttons, the user is pushed to think within a mysterious interface governed by capacitive touch plates wrapped into glyphs. Presented in a playful interface, the Grain Prism, drives the user to manipulate their own recorded voice or sounds of the environment with the addition of digital effects ultimately guiding their imagination into creating a sonic texture.

## 2. RELATED WORK

Analogique B (1959), was the first composition that used granular techniques by Greek-French composer, engineer and architect Iannis Xenakis. On the macroscopic level, the piece was composed by the artist, whereas on the microscopic level, the grain fragments were generated by mathematical models [7]. Xenakis also coined the term Stochastic music which, based on mathematical theories of probability and statistics, creates a guided aleatoric musical experience, in which every aspect abides by the laws of randomness [9].

On the other hand, the kinesthetic relationship between an instrument and its player help summon an aleatoric exploration of sound. An early example of such instruments is the Cracklebox, created by the Dutch musician Michel Waisvisz in the 1970's, uses the body's resistance to control various oscillators [5]. In more recent days, the Hyve-synth by Skot Wiedmann has a very sensitive multi-touch capacitive interface, capable of controlling up to 60 different oscillators [1]. With a commercial and heavily design-based approach in making products, the Swedish company and manufacturer Teenage Engineering launched in 2015 the Pocket Operator series [2]. Resembling vintage calculators with references to video games from the late 1980s used as a visual guide, it puts the user in a unorthodox medium through a puzzling interface that might lead to fortunate musical accidents. A similar approach was used in the design of the Grain Prism.



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### 3. DESIGN AND IMPLEMENTATION



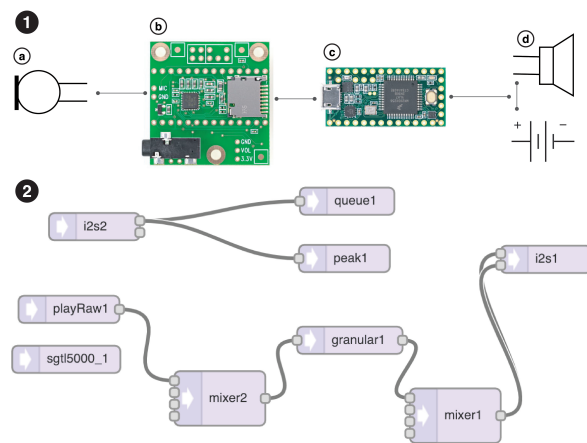
**Figure 2: Drawing inspiration from both hieroglyphs and circuit schematics**

The Prism uses the advantage that symbols have over words in triggering imagination. Incorporating a culturally mysterious alphabet as a reference point in the design, in combination with electronic schematics symbols, it offers a medium for storytelling through touch. Since there's no obvious design guidelines in the interface that resembles typical audio samplers/recorders, users will tend to create their own “mental mapping” of how the instrument works. The pyramidal geometry of the instrument hints out on some of its primitives. The audio gets recorded through the top of the pyramid and the sound is played through a speaker on its bottom. The Grain Prism enclosure is composed of 4 triangular PCBs joined by 3D printed parts. Each PCB has exposed copper drawings that work as capacitive touch points acting as digital buttons wired to a Teensy microcontroller and processed through Teensy's built in capacitive touch capabilities. Sounds are recorded from an electret microphone located at the very top of the instrument, whereas the bottom, includes an amplified speaker powered by a 5V lithium ion battery. The shape drives the player, who instinctively holds the instrument with both hands and touches a single or multiple glyphs to achieve sonic behaviors.



**Figure 3: Interacting with the Grain Prism**

The current version of the Grain Prism is a prototype built with the Teensy 3.2 microcontroller and a Teensy audio adaptor. The audio adaptor provides high quality 16 bit, 44.1 kHz sample rate audio. It also supports stereo headphone and stereo line-level inputs and outputs, as well as a mono microphone input and an SD card reader. The four outer PCBs have all the glyphs connected to the Teensy's touch and ground pins. The digital synthesis engine is implemented with the audio system design tool developed for the Teensy audio library. This design tool provides a visual programming interface similar to Pure-Data and Max/MSP with building diagrams that are specific to the Teensy hardware. Figure 4.2 features a simplified blueprint of the instrument. At its core is the granular synthesizer block, that also provides functions like changing the grain length, speed and amount. The tool provides a variety of digital effects that were also used in the making of the Grain Prism, namely, delay, reverb and bit-crushing [3].



**Figure 4: 1. The Teensy audio adaptor connected to a Teensy 3.2 a microphone and a speaker. 2. The sonic flow diagram of the instrument, built with the Teensy Audio Design GUI [3]**

### 4. FUTURE WORK

Future Grain Prisms can be equipped with additional sensing and more touch pins leading to extra layers of interactions. For instance, detecting the orientation of the instrument using an accelerometer could be mapped to recordings procedures. On the other hand, it would be very interesting to conduct a user study to evaluate the use cases of this instrument as played by various electronic musicians and composers.

### 5. CONCLUSION

This paper features the Grain Prism, an experimental musical sampler, that is presented through a mysterious capacitive touch interface. The player has to navigate an obscure sonic artifact while unlocking a mental diagram of the interaction through discovery, playfulness and storytelling.

### 6. REFERENCES

- [1] The hyve touch synthesizer.  
<https://www.hyvesynth.com/>.
- [2] Teenage engineering pocket operators series.  
<https://www.teenageengineering.com/products/po>.
- [3] Teensy audio design tool.  
<https://www.pjrc.com/teensy/gui/>.
- [4] L. Cross. Reunion: John cage, marcel duchamp, electronic music and chess. *Leonardo Music Journal*, pages 35–42, 1999.
- [5] E. Dykstra-Erickson and J. Arnowitz. Michel waisvisz: the man and the hands. *interactions*, 12(5):63–67, 2005.
- [6] J. Jeongwon and H. S. Song. Roland barthes' "text" and aleatoric music: Is "the birth of the reader" the birth of the listener? *Muzikologija*, (2):263–281, 2002.
- [7] C. Roads and J. Strawn. *The computer music tutorial*. MIT press, 1996.
- [8] P. Schaeffer, F. B. Mâche, M. Philippot, F. Bayle, L. Ferrari, I. Malec, and B. Parmegiani. *La musique concrète*. Presses universitaires de France, 1967.
- [9] M.-H. Serra. Stochastic composition and stochastic timbre: Gendy3 by iannis xenakis. *Perspectives of New Music*, pages 236–257, 1993.