The Conductive Kinetic Box

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ABSTRACT

The Conductive Kinetic Box is an experiment in creating a unified and portable tactile instrument made from five separate kinetic elements. These kinetic elements are paired with five circuits that connect into five small speakers allowing the instrument to be played both acoustically and electronically. As the kinetic elements move and connect with themselves, an electrical connection is made which turns the speakers on and off at the same rate as the physical connection. These elements are designed to make distinct sounds based on the physics of their motion and materials, but all are made with metal to ensure an electrical connection when powered. The Conductive Kinetic Box also explores repurposed and handmade materials as the wooden enclosure is handmade, and many of the metal elements are repurposed, such as a small wind chime, perches for hamsters and birds, aluminum foil, jar lids, photo holders, and a piece of a coat rack.

Author Keywords

NIME, proceedings, handmade instrument, design, kinetic, electronic music, sound art

CCS Concepts

•**Applied computing** → **Sound and music computing;** Performing arts; •**Human-centered computing** → *Interaction design;*

1. BACKGROUND

New discoveries in electricity in the mid-to-late 1800s laid the groundwork for explorations in audio technology, making the lineage of electroacoustic instrument design over a century old [6]. By the early 1900s with the invention of the triode vacuum tube, audio signals could be amplified, creating a wealth of options for early audio tinkerers [1]. Since then, numerous inventors and curious composers have tried to utilize the newest technology or harness the acoustics of unconventional materials to create new sounds. Artists and composers such as the Baschet Brothers, Harry Partch, Harry Bertoia, Jean Tinguely, among many others, have explored creating unified objects of sound-making elements that diverge from conventional musical instrument interfaces.

With the onset of transistorized electronics in the 1950s and 1960s, electronic instruments became smaller and more compact [3] [5]. Around the same time many technologies began adopting these solid state components, experiments in synthesis arose with Moog, Buchla, RCA, ARP, EMS, and others [6]. The convergence of smaller electronic parts and the ongoing experiments in instrument making paved the way for the creation of portable electronic instruments. Today, we can assemble full Eurorack units into small skiffs or suitcase-like cases. The goal of creating a portable, unified combination of sound-making devices continues to inspire inventors to design both electronic and electroacoustic instruments.

Many composers and instrument builders have explored combining both acoustic and electronic components into non-traditional enclosures. Mark Applebaum's "Mousetrap," "Mini-Mouse," and "Kindermaus" all exhibit playable acoustic elements combined into one unit that can then be amplified [2]. Other instrument builders such as Bart Hopkin, Tim Kaiser, and Bryan Day vary their instrument shapes and sizes but continue to combine acoustic elements with electronics in unique enclosures with novel interaction design. Finally, there are the hackers and electronics makers such as Reed Ghazala and Peter Blasser that work beyond the typical paradigm for electronics interfaces. There are a wealth of online shops and Etsy stores that include noise makers involving amplified springs, chain locks, CD spindles, and anything you can put a contact mic on. In fact, I had an Etsy shop of my own that sold slinky boxes, rubber band boxes, bead boxes, and noise mazes.

Most of these electronic and electroacoustic instrument inventions can be divided into two categories: one in which the performer must play the instrument with physical, tactile elements, such as a spring box or the "Mousetrap," and one in which the instrument allows for looping and layering sound as with a modular synth. However, what makes the Conductive Kinetic Box unique is that it can do both. Additionally, the kinetic motion is not amplified with a contact mic, but the motion itself makes a periodic electrical connection that triggers the speakers to turn on and off, what Nicolas Collins terms "speaker jumping" [4].

2. BEGINNINGS OF THE BOX

The Conductive Kinetic Box design stems from a series of performances I did with the concept of acoustic instruments that turn into electronic instruments. The first iteration was a live performance that included a record player connecting

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with a metal lid, a metal flag connecting with a fan that has a metal grill, a motorized cup spinning and connecting with a metal lid, and another fan connecting with foil as it blew the foil back and forth. These were all loosely assembled and alligator-clipped together for the flexibility conducive to the improvisatory nature of this composition. While this method worked well for individual performances, I began thinking about making a permanent version of these devices that would be simpler to set up and take down for live shows (Figure 1).

Figure 1: First Iteration Live Show

I created two more iterations of these assemblages, one for a livestream and one for an in-person showcase. The livestream performance included a slowly turning metal jewelry display connecting with a metal photo holder attached to metal piece of a coat rack, a piece of foil connecting with a metal lid via being blow by a fan, a metal slinky hanging over another metal photo holder being spun by a scientific magnetic stirrer, and finally, the first non-alligator clipped and somewhat solidly assembled version of this concept, a photo holder making contact with a foil-covered bottle cap attached to a metal 3-volt motor affixed to a wooden plank. Here the cap, motor, photo holder, speaker, and battery packs were either hot glued, set into small drill holes, or Velcroed to the wood (Figure 2).

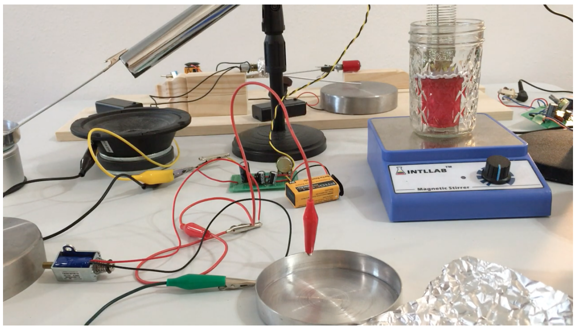

Figure 2: Second Iteration for Livestream

Finally, the last iteration that inspired this project saw some repeated elements. The wooden plank assembly remained, the hanging slinky over the magnetic stirrer remained, and the jewelry display, coat rack, and photo holder assembly remained. After this third version, the materials that would become part of the Conductive Kinetic Box began to take shape. Some of the elements that would make their way into the final version were the metal coat rack piece, the hanging slinky, the foil, metal lids, and the metal photo holders.

Figure 3: Mitered Joints

Figure 4: Before Drill Press and Band Saw

3. DESIGN PROCESS

One of the main requirements for the kinetic aspects of this piece are five distinct motions resulting in five distinct acoustic sounds. I wanted it to mirror my assemblage performances of many things combined into an object orchestra and to ensure that a variety of sounds were available when using this new instrument. Some of the experiments done in previous iterations of this project were carried over to the final version, but some elements were not different enough from the others, so more research had to be conducted. The combination of a hanging slinky into a metal dish, a moving wire across a piece of solder attached to a metal lid, a metal piece of a coat rack with a motor against it, a piece of foil attached to a lid connected to a motor, and a metal photo holder inside of a small wind chime became the final assemblage. While these kinetic elements have many parts to them, the idea is to ensure the electrical connection can be made and that the acoustic resonance is loud enough to mix with the electronics when the speakers are activated.

As far as the enclosure goes, the box was made with two pieces of plywood for the top and bottom and four mitered pieces of solid wood (Figure 3). The mitered pieces were glued and clamped together with a ratcheting band clamp and also with multiple bar clamps to the work table. Because the shop was humid, it was difficult to keep the plywood from warping, so a solution was to place cinder blocks on top of the box while it dried to ensure the box top fit properly with the base (Figure 4). After the glue dried, the sides were sanded with an oscillating belt sander. The speaker holes were done with a 2-inch Forstner bit on a drill press, and the area for the knobs and switches was carved out with a band saw. Initially, I was hoping to put the knobs and switches directly into the plywood but realized the wood was too thick for the nuts to screw in properly, so a solution was to use a thin piece of sheet metal and affix it to the plywood. The knobs are part of a pulse-width modulator circuit that was purchased, as it was cheaper to buy them pre-assembled in bulk, and the switches are simple single-pole single-throw toggles.

The circuitry was the more tedious element as the cable management was somewhat of a feat. I wanted the box to be thin and portable, but fitting the speakers and the wiring together was a tight fit. I balanced the top of the box with the speakers and kinetic elements between two stools and soldered them from beneath. I zip-tied and wound the wires and was able to get everything to fit around the speakers. The circuit is simple as it just connects the battery pack to one side of the kinetic element, from the other side of the kinetic element to the speaker, and finally from the speaker to the battery. The PWM circuit also has its own battery pack. So, fitting this many batteries into the box was also a challenge.

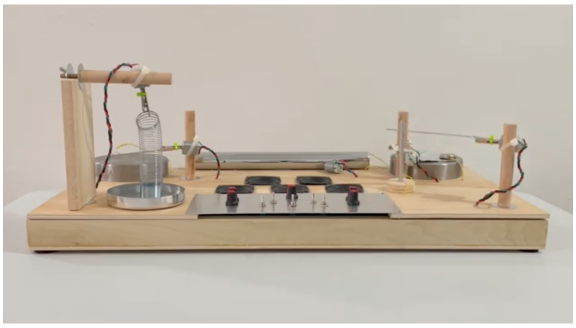

Figure 5: Final Box Design

Figure 6: Final Box Design Top View

4. FUTURE RESEARCH

The more pressing issue to solve for the future of this project is to have a more efficient power supply. Ideally, I would like to power the whole thing via wall supply so as to be able to leave it in a gallery as an interactive exhibit. I've used batteries for installations for up to a month in a gallery and didn't run across any issues, but it would be a better practice in general and a good learning experience to figure out how to run the Box with more efficient power.

Since I have continued to develop my knowledge of carpentry tools and techniques, I would also like to develop a new enclosure with more sophisticated joinery and perhaps a lid that slides into the box rather than sits on top. I like the look of natural wood, but I'd also like to buy a hardwood that can withstand more and doesn't get scratched as easily as this cheaper soft wood. I would stain the wood as well to protect it from humidity and damage.

5. DEMO VIDEO

A demo video demonstrating the Conductive Kinetic Box can be found here: demo video link

6. ACKNOWLEDGEMENTS

Thank you to Dr. Jesse Allison at the Louisiana State University School of Music for supporting this project and to Mark Shumake in the LSU School of Art Design Shop for his carpentry expertise.

7. ETHICAL STANDARDS

This project did not require consent to interview or participate in a study as it did not require human participants. While some of the carpentry tools used in this version may be inaccessible, this project can be completed with alternate ways of making the enclosure. Safety precautions should be followed when using power tools and soldering irons, but this project can be made with hand tools, a premade enclosure, or electronics parts that do not require soldering. This project is made from organic renewable resources and repurposed materials and is both economically and environmentally low impact.

8. REFERENCES

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