OCTODRUM

An electromechanical orchestrion device for performance and interaction on a steel tongue drum

SUMMARY

The purpose of this interdisciplinary project was to explore the intersection between engineering and the arts and to create a steel tongue drum robot capable of innovative performances, autonomous sequence generation, and human interactivity.

Figure 1: Full System

ENGINEERING REQUIREMENTS

- **Tempo (Actuation Frequency)**:

All mallets will be able to strike faster than 8Hz

- **Dynamic Range**:

There will be at least 3 distinct dynamic levels

- **Latency**:

Less than 50ms between MIDI input and actuator strike

- **Thermal Management**:

System withstands 1 minute of repeated actuation at highest achieved frequency

- **MIDI Input**:

Standard USB MIDI protocol controls each mallet arm independently

- **Autonomous Performance**:

Audience agrees that the OctoDrum generates interesting music

- **Human Interactivity**:

Autonomous performance is noticeably responsive to interaction via distance sensors

- **Power Supply**:

Only requires power from one US outlet and one USB cable

Oregon State University

SYSTEM-LEVEL BLOCK DIAGRAM

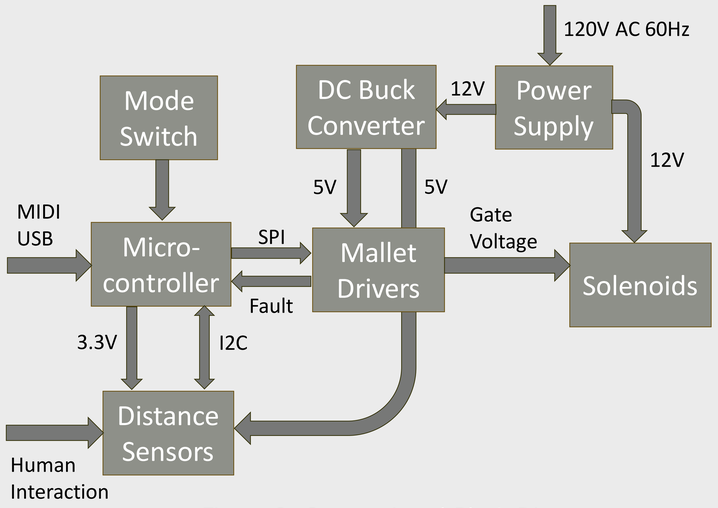


Figure 2: System-Level Block Diagram

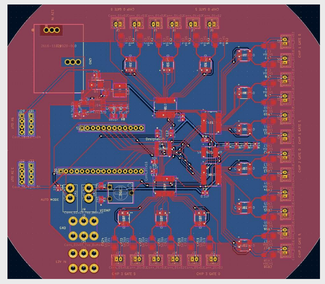


Figure 3: Fully-Integrated PCB Layout

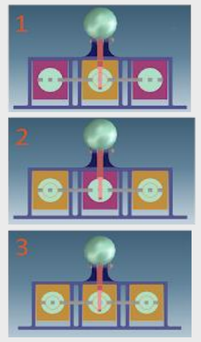


Figure 4: Dynamic Levels for 3-Solenoid Design

HARDWARE

Power

- Power supply provides stable 12V DC to the solenoids from standard electrical outlet with ON/OFF switch, 24 amps peak current
- DC buck converter regulates internal 5V supply for distance sensors and mallet driver circuitry

PCB

- Serial Peripheral Interface on pre-FET drivers controls 24 MOSFET devices which actuate solenoids with flyback protection
- Open-load and shorted-load fault protection

Sensors

- SHARP infrared distance sensors detect linear proximity from 20cm to 150cm on each arm
- Dynamically adjusts drumming speed based on performer and/or spectators for an interactive musical experience once system is in sensor mode

SOFTWARE

MIDI Input

- Adafruit Feather M4 Express receives real-time USB MIDI data and sends appropriate SPI messages to mallet driver ICs

Autonomous Performance

- Microcontroller generates music sequences using Markov matrices and probability distributions

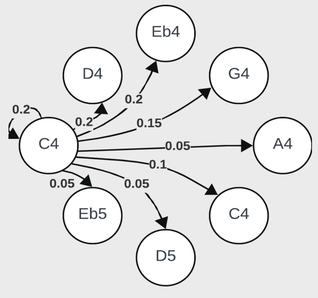
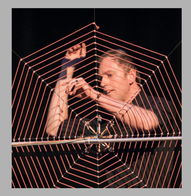


Figure 5: Markov Chain example for one note, C4

PROJECT CUSTOMER



Dr. Chet Udell is an Associate Professor of Biological & Ecological Engineering at OSU, director of OPEnS lab, and designer of electronic music instruments.

The OctoDrum is the first of Dr. Udell's lineup of orchestrions — interactive electromechanical musical instrument systems. Go to chetudell.com to check out his other innovative musical projects.

ENGINEERING TEAM

The OctoDrum was designed by a multidisciplinary team of electrical and mechanical engineering students.

Left to Right: Nicholas Kim, Kexin Liu, Gianluca Rianda, Liam Warner, Liam Hodge, and Luke Lutnesky

ECE TEAM MEMBERS

Nicholas Kim

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PCB design/layout/assembly, solenoids

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Liam Warner

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Programming, microcontroller interface validation, autonomous mode design

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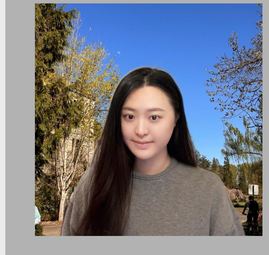

Kexin Liu

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Power supply, DC buck convertor, IR sensor design

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