

Tiny trainable instruments

by

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Abstract

Tiny trainable instruments is a collection of instruments for media arts, using machine learning techniques and deployed in microcontrollers.

Thesis Supervisor: Tod Machover

Title: Muriel R. Cooper Professor of Music and Media

Acknowledgments

UROPs Peter Tone, Maxwell Wang

Opera of the Future

Future Sketches

Family and friends

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Chapter 1

Introduction

1.1 Context

Opera of the Future Futuer Sketches 2019-2021

Classes I took: Comparative Media Studies

Other projects: SiguesAhi, Open Drawing Machine, Introduction to network for artists.

1.2 Section sample

Nulla sed sem finibus, vehicula quam at, vulputate tellus¹

¹Here is a sample footnote referencing figures ?? and B-1.

1.2.1 Subsection sample

1. Item 1.

Chapter 2

Background

2.1 Instruments

2.1.1 BASTL

BASTL Kastle, two iterations and a spinoff: Kastle, Kastle v1.5, Kastle Drum.

Based on Arduino, GitHub repository with alternate firmware.

Breadboard patching with jumper cables, inputs and outputs robust enough to allow for mistakes in connections.

2.1.2 Critter & Guitari

Organelle computer for sound, scriptable, Linux operating system + Pure Data software.

ETC and EYESY computers for visuals, scriptable, Linux operating system + Python

/ pygame environment or openFrameworks.

2.1.3 monome

Aleph: sound computer

Norns: sound computer, currently on its second iteration, with expanded hard drive. Also there is a DIY version which is cheaper and runs on a Raspberry Pi. Norns is a Linux machine, running SuperCollider for the sound engine, and Lua scripts.

2.1.4 Shbobo

Peter Blasser's Shbobo

Shnth and Shtar

Shlisp language and Fish IDE.

github.com/pblasser/shbobo

2.2 Education

Mitch Resnick's book Lifelong Kindergarten

Low floor, wide walls, high ceiling

Peers, projects, passion, play

Gene Kogan and Andreas Refsgaard

2.3 Machine learning

ml5.js

Runway

TinyML Professional Certificate HarvardX

2.4 Digital rights

Electronic Frontier Foundation

Edward Snowden

Design Justice Network

Chapter 3

Early experiments

3.1 Microcontrollers

Arduino

Teensy: MIDI plug in.

3.2 Machine learning

Class at School of Machines by Gene Kogan and Andreas Refsgaard

Chapter 4

Tiny trainable instruments

4.1 Design principles

1. Cheap

2. Privacy

4.2 Technology

Arduino microcontoller

Arduino library KNN

TensorFlow Lite Micro

4.3 Programmable / remix

4.4 Philosophy and experience

4.5 Inputs

Enumerate sensors from the Arduino Nano 33 BLE Sense

4.6 Outputs

Buzzer

Servo

MIDI: Korg volca beats, cheap and still in production.

4.7 Development

Team with Peter Tone and Maxwell Wang.

We have a shared Google Drive folder, where we all share notes about our research and development of the library and the educational material.

Peter has done research on code and data structures.

Maxwell researches ways of teaching our topics, and has been documenting and writing the documentation and tutorials.

4.8 Opera of the Future projects

Squishies Fluid music

Chapter 5

Project evaluation

5.1 Digital release

GitHub repository

Arduino library

5.2 Audience engagement

PDF zine for explaining, reference as the PDF booklet for monome norms

5.3 Workshop

Applied to grant at CAMIT for teaching the workshops in English in USA, and in Chile in Spanish, remotely over Zoom.

Each workshop consists of 2 sessions of 3 hours each, spread over a weekend.s

5.4 Multimedia show

Chapter 6

Conclusion

This thesis project is a

6.1 Future work

6.1.1 Education

New workshops, using multimedia outputs.

6.1.2 Artist workflow

Training instead of programming.

6.1.3 Packaging

Low hanging fruit is to package a Tiny Trainable Instrument with a set of particular outputs, on a perfboard or PCB.

The next step would be to create enclosures.

6.1.4 Gallery

Appendix A

Tables

Table A.1: Armadillos

Armadillos	are
our	friends

Appendix B

Figures

Figure B-1: Armadillo

Bibliography