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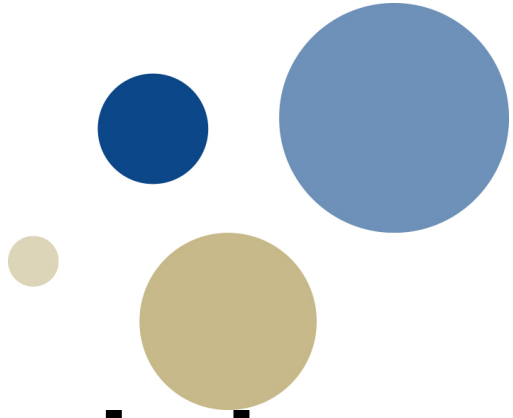

Physical Computing Workshop: Day 3

Microcontrollers, tangible bits and chiptunes

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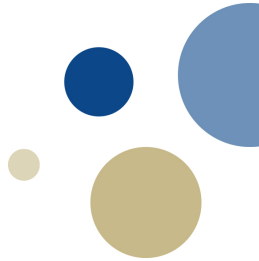
Learning Outcomes

- Get an overview of the possibilities of interaction in physical computing applied to music.
- Identify the main characteristics of the Arduino board.
- Explore the creation of interactive systems for music using the Arduino board.
- Get familiar with the littleBits kit.
- Be able to create a music patch with littleBits.
- Demonstrate a custom-made musical instrument in a performance setting.
- Reflect on the custom-made musical instrument and performance using a blogging style.

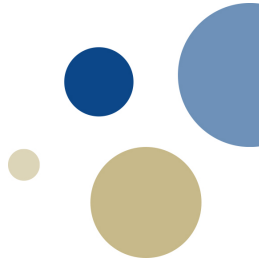
Preparation: Reading



— Read / skim through the following article and be ready to discuss it in class:

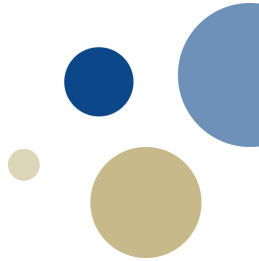
- Collins, N., 2010. Interaction (chapter 6). In Introduction to Computer Music. Wiley.
  `https://goo.gl/zor5gN`

Preparation: What to Bring to Class?



— Your own laptop.
— Headphones / earplugs.

Preparation: What We Do Provide?



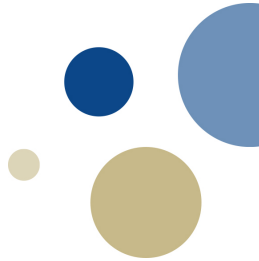
- 7 Music Angel speakers for the performance per site.
- 6 Arduino Kits per site.
- Slides:
  `https://github.com/axambo/physical-computing-workshop/blob/master/slides/04-d3/pcw-d3.pdf`.
- Code:
  `https://github.com/axambo/physical-computing-workshop/tree/master/exercises/04-d3`.
- A handout:
  `https://github.com/axambo/physical-computing-workshop/blob/master/handouts/pcw-d3-handout.pdf`.

Pre-knowledge Activity: Interaction

Be ready to discuss topics related to interaction from the suggested reading. In a round of 1-minute per each person briefly comment:

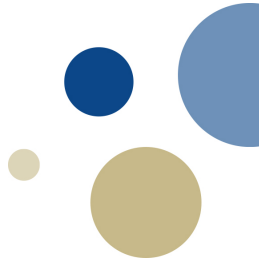
- What is interaction in computer music for you?
- What is your favorite input device and why.

Outline



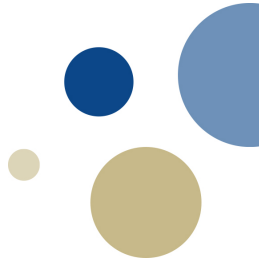
- Block I: Getting familiar with the Arduino board
- Block II: Basic interactive behavior activities: tangible bits
- Block III: Rehearsal and performance

Exercise 1: Arduino as an IKEA kit



- Explore the content of the Arduino experimentation kit, ideally in pairs.
- Follow the initial steps of the booklet: get familiar with the components and install the Arduino IDE software (page 3 of the booklet.
- Have a close look at the breadboard.r
- Have a close look at the Arduino board and the types of pins.

Exercise 2: “Hello, World!”



— The “Hello, World!” in Arduino: Blinking LED exercise: 1) run the example from Arduino IDE (File>Examples>01.Basics>Blink) blinking the built-in LED, 2) plug an LED to 13, what happens? 3) create the circuit from CIRC-01 of the Arduino Kit (pages 8–9 of the booklet), which controls an LED in the breadboard.

Exercise 3: The piezo electric buzzer

When applying a voltage to the contact mic or piezo buzzer, it will produce an audible click, due to the two inner discs (metallic and ceramic) repel each other.

— Create the circuit from CIRC-06 of the Arduino Kit (pages 18–19 of the booklet).

— Run the code explained in page 7 from “Arduino 8-bit sound generation” (`https://www.elektormagazine.com/files/attachment/331`). Make sure that the pin number is correct.

— Explore different times. What happens if the delay is 1ms?

— Try now the “Bee” program explained in page 9 of the same book.

Exercise 4: Playing tones

Arduino cannot imitate the sinusoidal shape perfectly. However, we can produce square waves by repeatedly switching a pin HIGH and LOW. Microcontrollers work with time (as opposed to frequency). We can define a particular frequency by defining the time period.

$$p = \frac{1}{440} = 0.002272s = 2.272ms = 2272\mu s$$

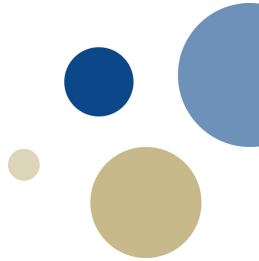
- Explore the different notes (C4–C5) provided in page 10 from "Arduino 8-bit sound generation" (`https://www.elektormagazine.com/files/attachment/331`).
- Challenge: Run the code from `https://www.arduino.cc/en/Tutorial/Melody` and change the melody.

Exercise 5 (optional): Cloud computing with Arduino and P5.js

Serial communication to a web page in a browser is possible, and thus we can communicate browser-based applications with Arduino! Here are some tutorials that are informative on how to proceed towards this direction.

- Asynchronous serial communication: the basics: `https://itp.nyu.edu/physcomp/lessons/serial-communication/serial-communication-the-basics/`
- Serial input to P5.js: `https://itp.nyu.edu/physcomp/labs/labs-serial-communication/lab-serial-input-to-the-p5-js-ide/`
- Serial output from P5.js: `https://itp.nyu.edu/physcomp/labs/labs-serial-communication/lab-serial-output-from-p5-js/`

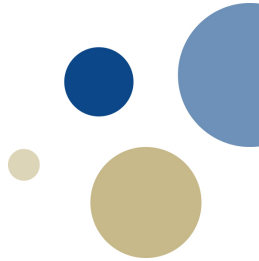
Exercise 6: Chiptunes with litteBits



— Explore the different pieces of litteBits, get familiar with the collection.

— Build a music patch.

Resources



- How to use a breadboard:
  `https://youtu.be/6WReFkfrUIk`
- How to use a resistor:
  `https://www.youtube.com/watch?v=GLD7AgAYqwA`
- An Introduction to the Arduino:
  `https://www.youtube.com/watch?v=CqrQmQqpHXc`
- What is an Arduino? (Arduino Uno pinout diagram included):
  `https://learn.sparkfun.com/tutorials/what-is-an-arduino/all`
- Serial Output From Arduino: `https://vimeo.com/237203208`