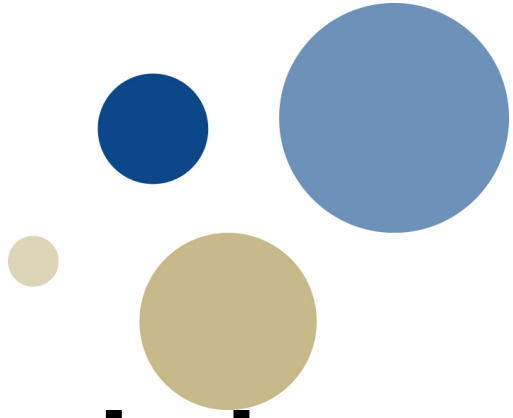
NTNU
Norwegian University of
Science and Technology



Physical Computing Workshop: Day 1

Intuitive circuits and hacking

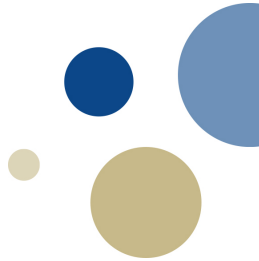
Anna Xambó
Department of Music, NTNU

16 October 2018

Learning Outcomes

- Identify the fundamental properties of a circuit.
- Explore the practice of circuit sniffing using radios, microphones and speakers.
- Discover the research and artistic technique of soundwalks.
- Discern the fundamental properties of an interactive system.
- Get familiar with web technologies (P5.js, javascript).
- Be able to adapt javascript code of a sampler with custom recordings.
- Demonstrate a custom-made sampler instrument in a performance setting.
- Reflect on the custom-made sampler instrument and performance using a blogging style.

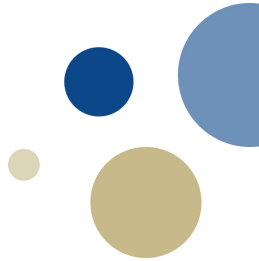
Preparation: Reading + Questionnaire



— Read / skim through the following article and be ready to discuss it in class:
  - Collins, N. (2004) The Seven Rules of Hacking (chapter 2) [1]: `http://www.nicolascollins.com/texts/originalhackingmanual.pdf`
  - Adams, M.D. et al. (2008) “Soundwalking as a methodology for understanding soundscapes” [2]: `http://usir.salford.ac.uk/2461/1/Adams_etal_2008_Soundwalking_as_Methodology.pdf`

— Fill in the following questionnaire before coming to class: `https://goo.gl/gW6XEm`

Preparation: What to Bring to Class?

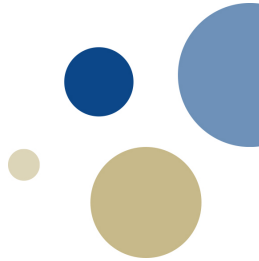


- Cheap headphones / earplugs.
- A mobile phone with a radio program or a battery-powered AM radio.
- A minijack to jack adapter.
- Extra 9V batteries.
- A battery-powered amplifier (optional, you will have 1 per group).
- Any type of contact mic, pickup or piezo (optional, you will have 1 per group).
- Your own laptop.

Preparation: What We Do Provide?

- A spreadsheet for block I: circuit sniffing and soundwalking activities:
  `https://github.com/axambo/physical-computing-workshop/tree/master/templates/02-d1`.
- 3 mini amps per site.
- 3 piezo transducer pickups per site.
- 7 Music Angel speakers for the performance per site.
- Slides:
  `https://github.com/axambo/physical-computing-workshop/blob/master/slides/02-d1/pcw-d1.pdf`.
- Code:
  `https://github.com/axambo/physical-computing-workshop/tree/master/exercises/02-d1`.
- A handout:
  `https://github.com/axambo/physical-computing-workshop/blob/master/handouts/d1-handout.pdf`.

Outline



- Block I: Circuit sniffing + soundwalking activities
- Block II: Basic interactive behavior activities: building a sampler around the morning's audio recordings
- Block III: Rehearsal and performance

Pre-knowledge Activity: Soundwalks

Be ready to discuss about soundwalking from the suggested reading.

Block I: Circuit sniffing + soundwalking activities

- Combination of soundwalks and circuit sniffing.
- Mapping of materials / situations that work for different conditions (filling in the provided spreadsheet).
- Generation of audio recordings for later use.
- Distribution of work between group members in the wild and group members in the “station”.
- Each group will present their results for one of the soundwalk activities.
- This material will be used for the daily blog.

The seven basic rules of hacking (Collins 2006)

- Rule #1: Fear not!
- Rule #2: Don’t take apart anything that plugs directly into the wall.
- Rule #3: It is easier to take something apart than put it back together.
- Rule #4: Make notes of what you are doing as you go along, not after.
- Rule #5: Avoid connecting the battery backwards.
- Rule #6: Many hacks are like butterfies: beautiful but short-lived.
- Rule #7: In general, try to avoid short circuits.

Exercise 1: Radios and interferences

Radios pick up electromagnetic waves and translate them into signals that can be heard through the loudspeaker.

- Go for a soundwalk with a radio using the circuit sniffing technique and try moving it around various electrical appliances (e.g. fluorescent lights, infrared remote controls, computers...).
- Annotate on the spreadsheet and record what is interesting.

Exercise based on “Chapter 3. Circuit sniffing: using radios and coils to eavesdrop on hidden electromagnetic music” (Collins 2006).

Exercise 2: Speaker as a microphone

Headphones are tiny speakers (both have coils and magnets to transform acoustic sound into an electrical signal or the other way around). The same electromagnetic force is used for both microphones and speakers.

- Go for a soundwalk with headphones as speakers using the circuit sniffing technique.
- Annotate on the spreadsheet and record what is interesting.

Exercise based on:

- "Chapter 4. In/out (the eight rule of hacking): speaker as microphone, microphone as speaker – the symmetry of it all" (Collins 2006)
- Video "Tutorial 2: In/Out - Electromagnetism Explained (Chapter 4)" (source: www.nicolascollins.com) `https://www.nicolascollins.com/video/tutorial02/tutorial02-desktop.m4v`

Exercise 3: Contact mics and amps

A contact mic, also known as a pickup or piezo, is a form of microphone that senses audio vibrations through contact with solid objects.

- Go for a soundwalk with contact mics and amps using the circuit sniffing technique.
- Annotate on the spreadsheet and record what is interesting.

Exercise based on:

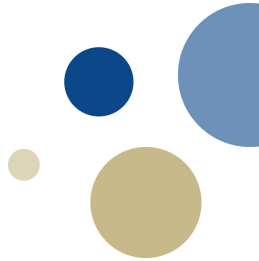
- "Chapter 3. Circuit sniffing: using radios and coils to eavesdrop on hidden electromagnetic music" (Collins 2006)
- Video "Tutorial 1: Circuit Sniffing (Chapter 3)" (source: www.nicolascollins.com)
  `https://www.nicolascollins.com/video/tutorial01/tutorial01-desktop.m4v`
- Video "Tutorial 5: How to Make a Contact Mike (Chapter 7)" (source: www.nicolascollins.com)
  `https://www.nicolascollins.com/video/tutorial05/tutorial05-desktop.m4v`

Exercise 4: Install P5.js and “Hello, World”

Exercise: Download and familiarize with the code from “P5_01_hello_world” project. Print “Hello, World” to the javascript console. Each student should have a laptop/terminal. In each terminal there should be installed:

- A code editor (e.g. Atom, Sublime...).
- A browser.
- Python to run a simple local server (as explained here: `https://github.com/processing/p5.js/wiki/Local-server`).
- Internet.
- Optionally: Headphones (if we want to avoid disturbing the other students).
- For each project it will be included P5.js library including p5.sound.js.

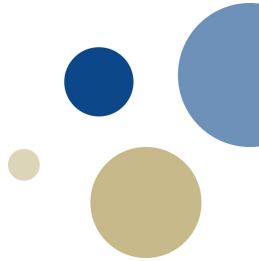
Exercise 5: A simple sampler in P5.js



Go through the code and exercises from:

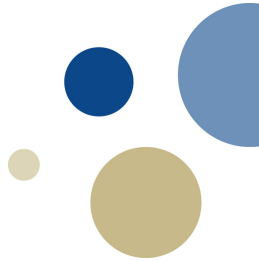
- “P5_02_loadSound”
- “P5_03_loadSound_playstop_keyboard”
- “P5_04_loadSound_play_four_sounds”

Exercise 6: A customized sampler in P5.js



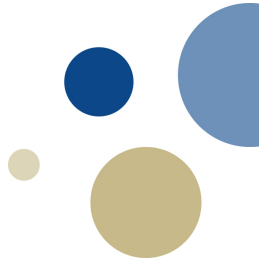
Create your own sampler with today's recordings. Be ready to perform with it!

Resources: Soundwalks



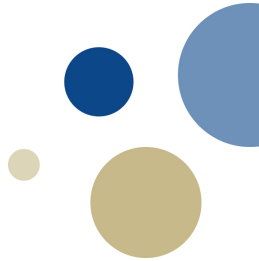
— Soundwalking as a methodology for understanding soundscapes (paper)
`http://usir.salford.ac.uk/2461/1/Adams_etal_2008_Soundwalking_as_Methodology.pdf`

Resources: Circuits



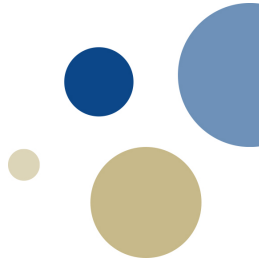
— Basic electricity - What is an ampere / amp? (video):
`https://www.youtube.com/watch?v=8gvJzrjwjds`
— Circuit fundamentals (video):
`https://www.youtube.com/watch?v=MusUypbX73Y`

Resources: Contact mics



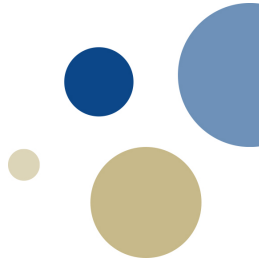
- Different Types of Transducers in Practical Applications:
  `https://www.efxkits.com/blog/different-types-of-transducers-in-practical-applications/`
- The first rule of CONTACT MIC club:
  `http://www.musicofsound.co.nz/blog/the-first-rule-of-contact-mic-club`
- 9 ways to use piezo mics in your music making:
  `https://www.musicradar.com/tuition/tech/9-ways-to-use-piezo-mics-in-your-music-making-627533`
- Building contact mics:
  `http://maaheli.ee/main/building-contact-microphones/`
- How to use a contact mic for sound design:
  `http://www.synthtopia.com/content/2016/08/15/how-to-use-a-contact-mic-for-sound-design/`

Other Resources: Engineering



- What is Electrical Engineering?
  `https://www.youtube.com/watch?v=QQewdCJTcIU`
- Inspiring the next generation of female engineers
  `https://www.youtube.com/watch?v=FEeTLopLkEo`

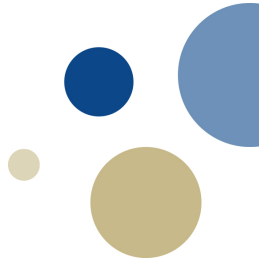
Other Resources: How to Solder



— “Chapter 6. How to solder? An essential skill” (Collins 2006)
`https://www.nicolascollins.com/video/tutorial04/tutorial04-desktop.m4v`

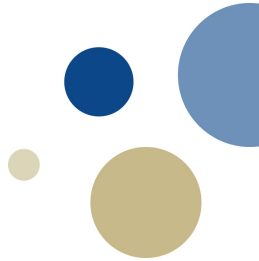
— How to solder? (video) (source: www.nicolascollins.com)
`https://www.nicolascollins.com/video/tutorial04/tutorial04-desktop.m4v`

Other Resources: Listening



- "Tutorial 3: Jumping Speakers (Chapter 5)" (source: www.nicolascollins.com)
  `https://www.nicolascollins.com/video/tutorial03/tutorial03-desktop.m4v`
- Alvin Lucier's (USA) "Sferics" (1980)
  Audio: `https://www.youtube.com/watch?v=rxUvMl_IxoQ`
  About: `http://www.alvin-lucier-film.com/sferics.html`
- Karlheinz Stockhausen (Germany), "Kurzwellen" (1968) used four receivers in live performance
  Audio: `https://www.youtube.com/watch?v=uQ_vGr9U3QY`
- "Pack: contact microphone recordings" by klankbeeld
  `https://freesound.org/people/klankbeeld/packs/11282/`

Other Resources: Listening II



— “Storytable” by composer Gyrid Nordal Kaldestad, performed by Architek Percussion (Ben Duinker, Mark Morton, Ben Reimer, Alessandro Valiante):
`https://vimeo.com/184034352`

— Owen Green and his work on cardboard boxes.
“Neither the Time Nor the Energy” (Electric Spring 2018):
`https://www.youtube.com/watch?v=VExDlHD7o80`

References

[1] Nicolas Collins. *Handmade Electronic Music: The Art of Hardware Hacking*. New York: Routledge, 2004.

[2] Mags D Adams et al. “Soundwalking as A Methodology for Understanding Soundscapes”. In: (2008).