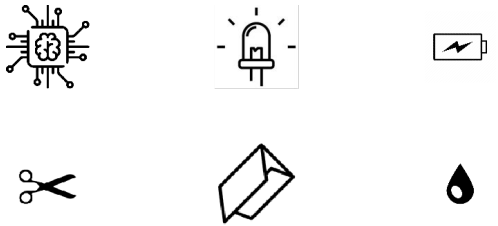
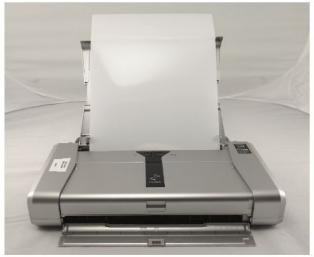


Paper, Ink & Electronics

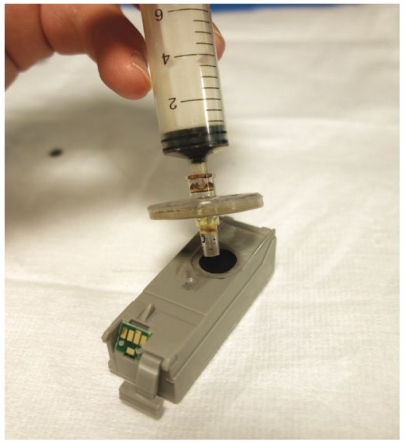
2. Printing Techniques
Clemens Wegener
October, 25th 2021

Bauhaus-Universität Weimar

Inkjet Printing



(a)



(b)

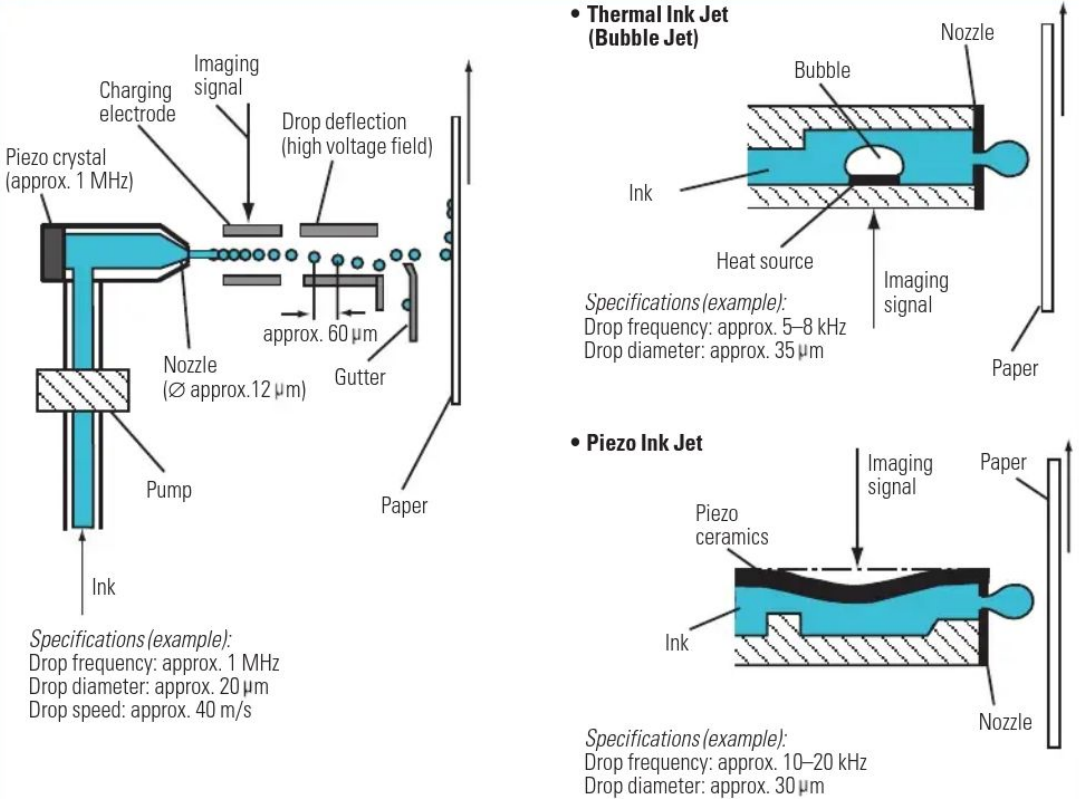
Using domestic printers for instant inkjet circuit fabrication:

(**a**) the brother DCP-J140w and Canon iP100 printers

(**b**) third-party inkjet cartridges filled with Mitsubishi silver nanoparticle ink using a syringe and disposable filter.

Source [1].

Inkjet Technologies



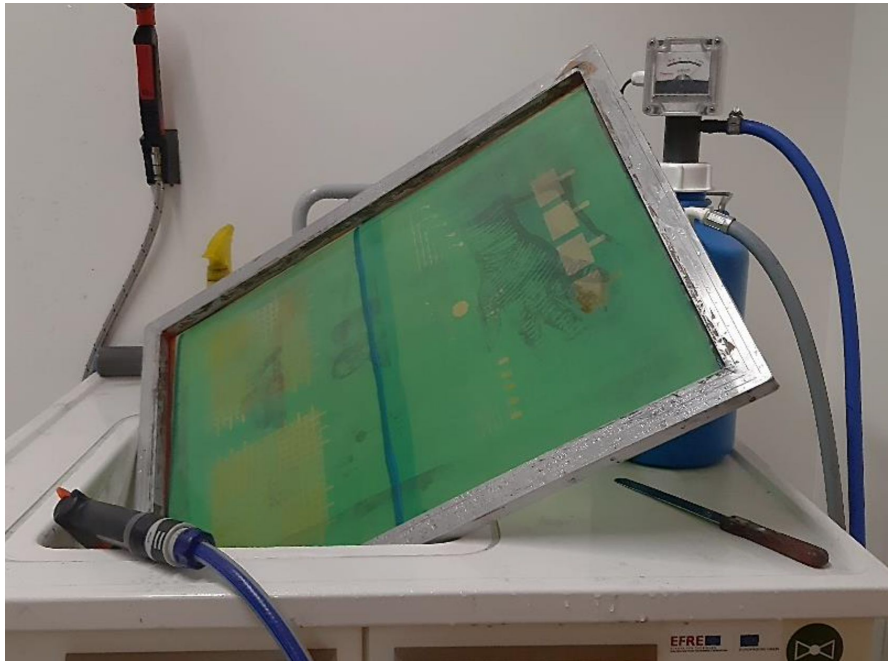
a Continuous;
b Drop on demand.

Source [2].

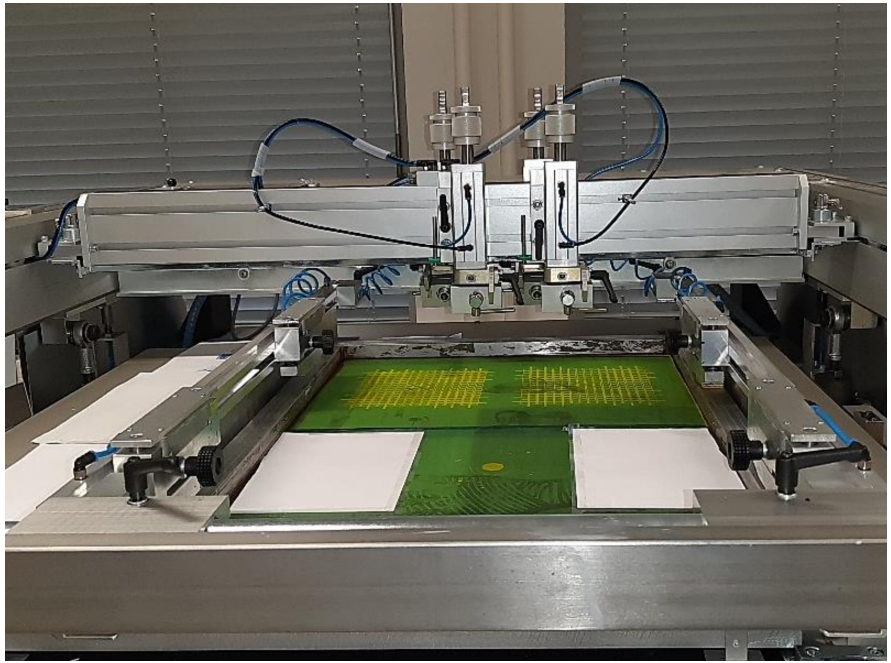
Screen Printing

Thieme 510 screen printing machine in the Bauhaus Form & Function Lab.

Screen Printing

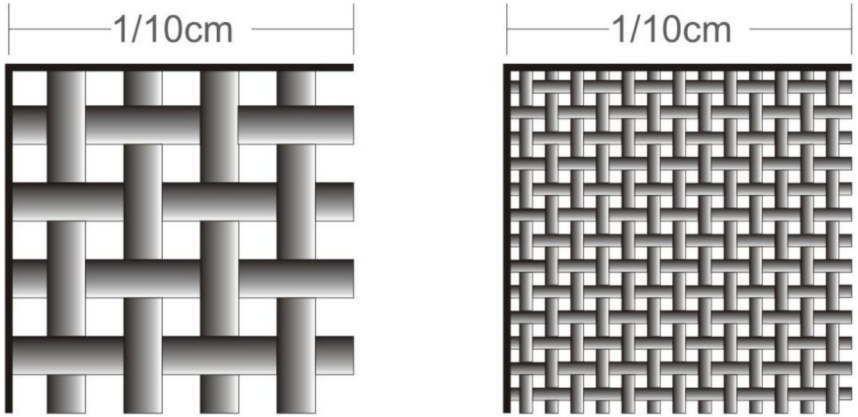


New developed screen after washing out coating.



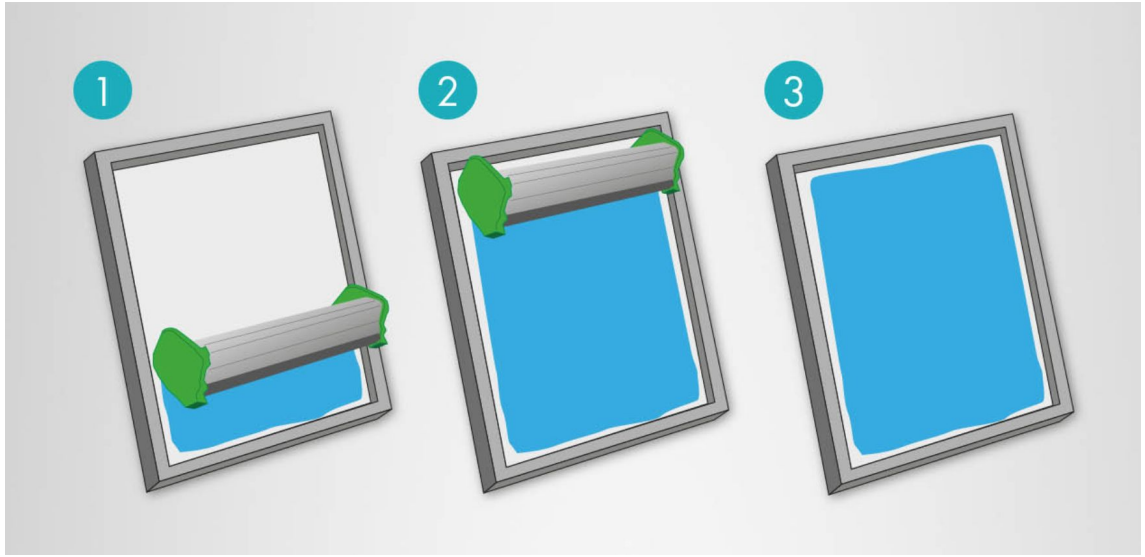
Screen inside the Thieme 510 before printing.

Mesh



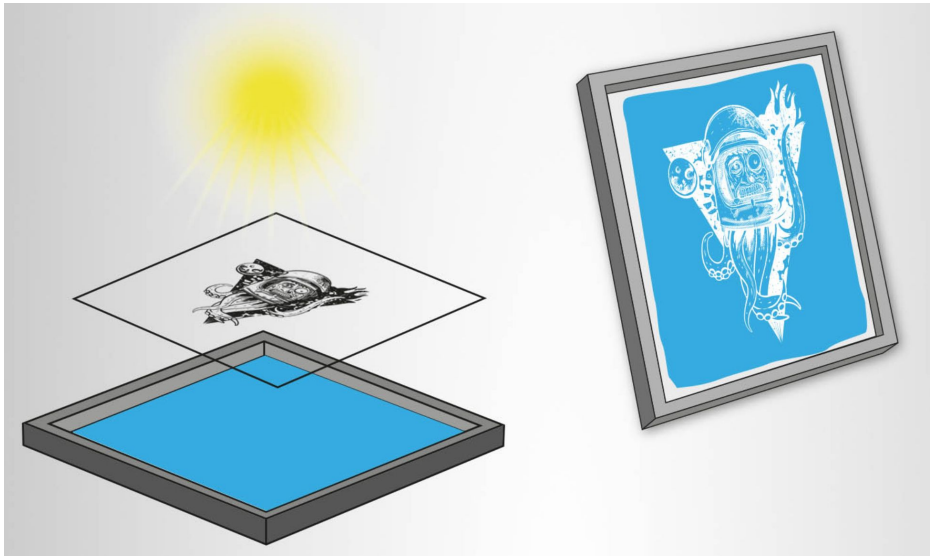
Left: low mesh count, 40 threads per cm,
right high mesh count, 130 threads per cm.
Source: [4].

Developing the screen



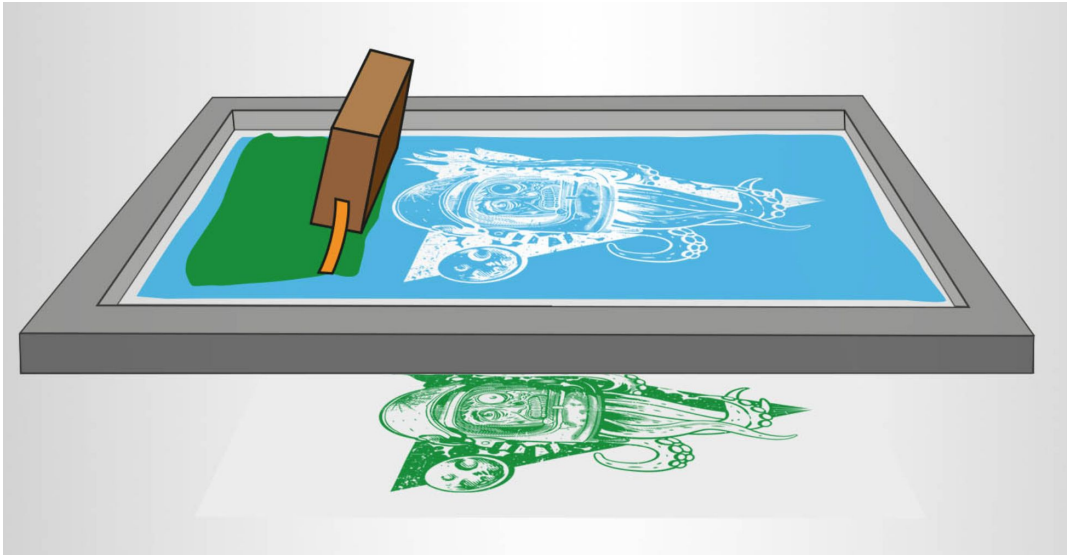
Coating with photo emulsion. Source [3].

Developing the screen



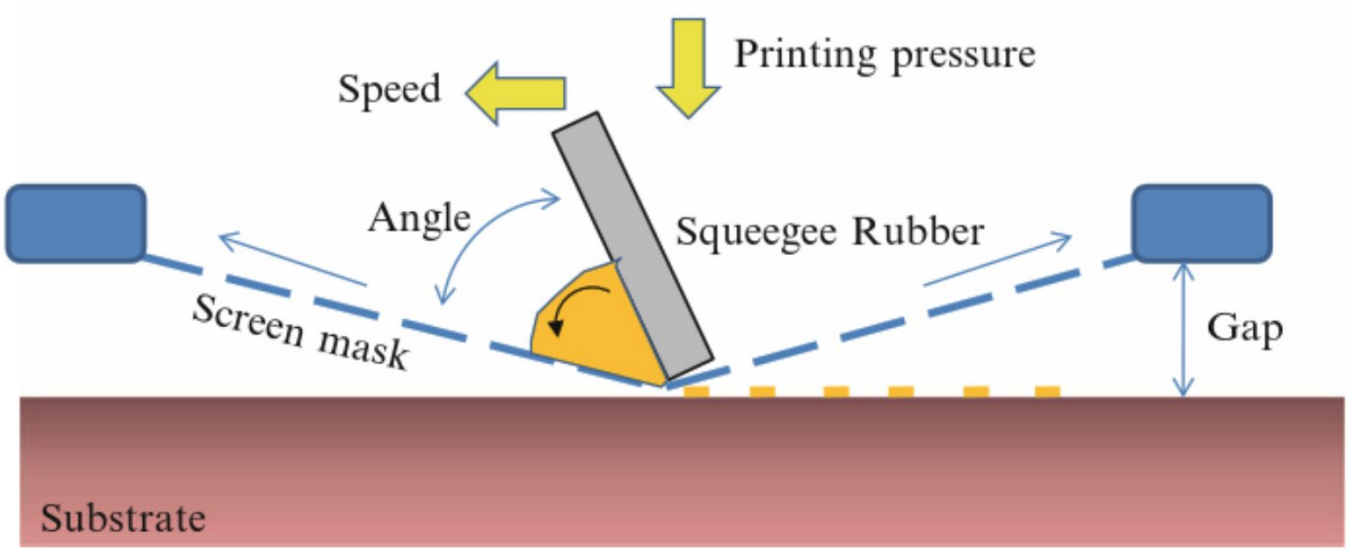
Developing the screen. Source [3].

Developing the screen



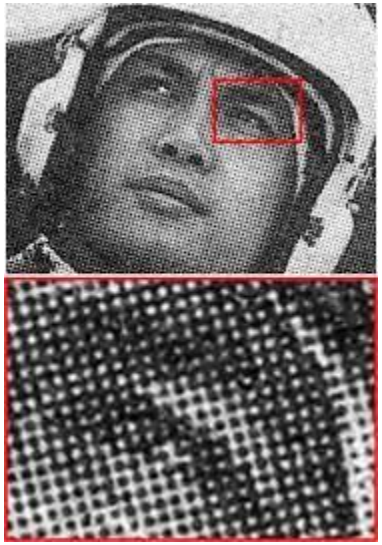
Developing the screen. Source [3].

Screen Printing



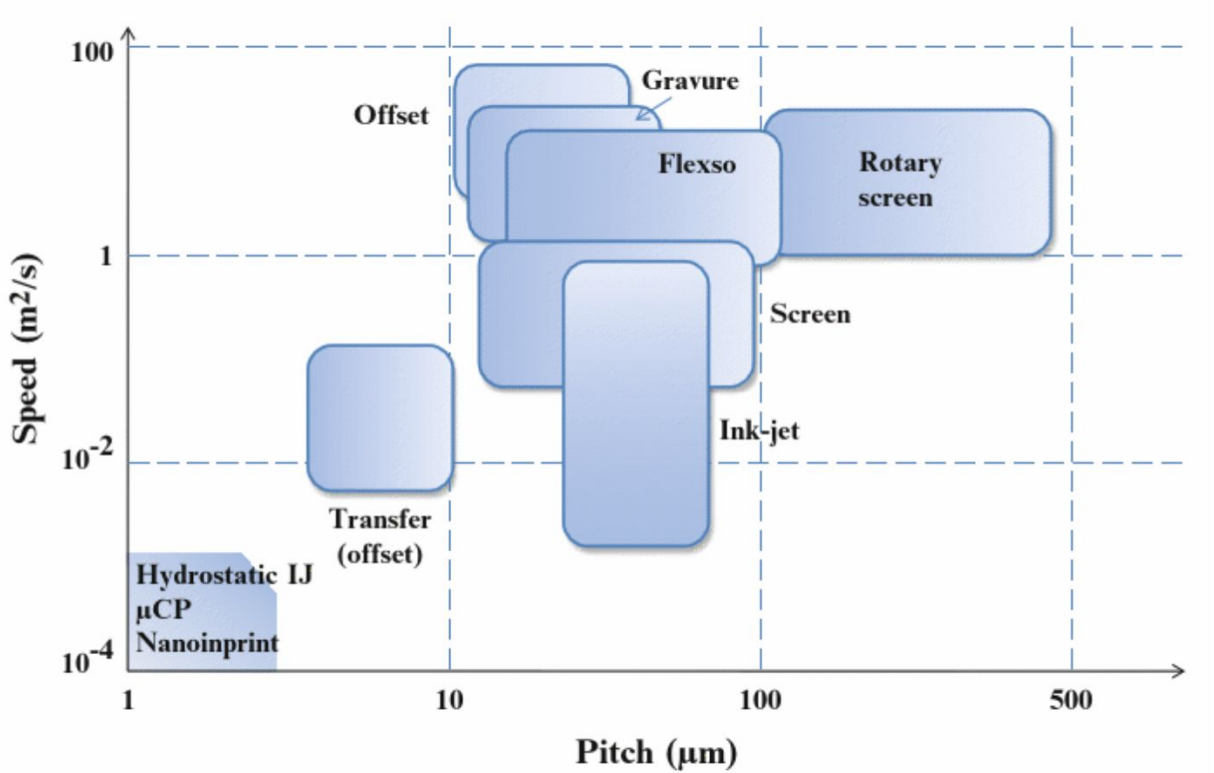
Parameters of screen printing. Source [2], p. 32.

Screen Printing



Screen printed half tone pattern, Source [10].

Print resolution



Throughput vs. fine pitch comparison for various printing methods.

Source [2], p. 24.

Conductive silver ink pens

Mitsubishi Circuitry Marker. Source [5]

Circuit Scribe. Source [6]

Mitsubishi
resin-coated paper.
Source [5]

Carbon based ink

Bare conductive electric paint [7].

- Good for capacitive sensing designs
- Carbon based,
- High sheet resistance: 55Ω/sq at 50 micron film thickness
- Screen printing: 43T – 90T polyester or stainless steel screen
- Vehicle: Water-based
- Drying temperature: Room temp for 5-15 minutes

Source [7].

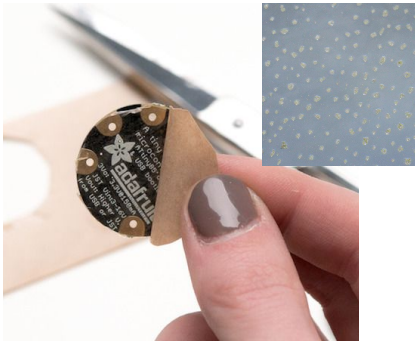
Other tools

Graphite pen.

- Graphite (carbon) based,
- Can be used to draw resistors
- Resistance is varies with applied layers

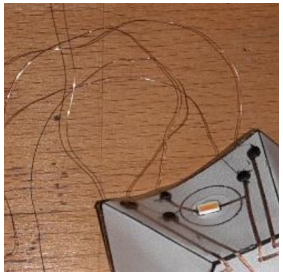
Foil connector [9].

- Reliable wire-to-sheet connections
- E.g. to arduino



Z-Axis tape [8].

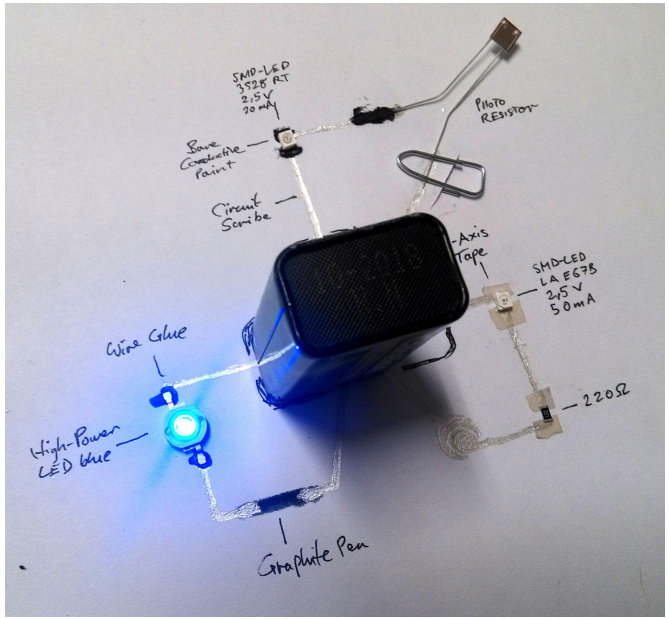
- Double sided tape,
- Conducts in z-axis only
- Contains tiny grains of conductive material
- Needs relatively big surface area



Mod wire.

- alternative wire-to-sheet connections
- Glue e.g. with Bare Conductive Paint

Next week's workshops



Studying materials and tools [6].

- In groups of 6-7 people
- Two time slots:
  - 9:15 am - 10:45 am
  - 11:00 am - 12:30 pm
- Bring a 9V battery!
- Look out for inspiration:
  - Jackson, Paul: Vom Faltobjekt zum Werbeträger: Schneide- und Falttechniken im Papierdesign. Bern: Haupt Verlag, 2013.
  - Klanten, Robert (ed.): Papercraft : design and art with paper. Berlin: Die Gestalten Verlag, 2009.
  - Avella, Natalie: Paper Engineering : Papier als 3D-Werkstoff. München: Stiebner, 2004.
- We will build circuits with LEDs, switches and push buttons

Syllabus (updated 27th Oct.)

- Mo, 18.10.2021 (online)
  - Meet & greet,
  - Short intro
  - Needed material
- Mo, 25.10.2021 (online)
  - Introduction to electronics
  - Inkjet & screen printing
  - Manual circuits & Connections
- Mo, 1.11.2021 (M7 002)
  - Workshop 1: manual circuits
- Mo, 8.11.2021 (M7 002)
  - Workshop 2: inkjet printing
- Mo, 15.11.2021 (M7 002)
  - Workshop 3: screen printing
- Mo, 22.11.2021 (online)
  - Arduino programming & libraries
- Mo, 29.11.2021 (online)
  - circuits for speakers and microphones
- Mo, 6.12.2021 (online)
  - Project proposals & inspiration sessions
- **Mo, 13.12.2021 (M7 002)**
  - **Presentation of project ideas**

-- Christmas Break! --

- 3.1.2022 - 7.2.2022 Workshop Sessions
- **Mo, 14.2.2022 Final Presentations**
- **Mo, 28.3.2022 Hand in documentation**

Sources

[1] Y. Kawahara, S. Hodges, N. Gong, S. Olberding and J. Steimle, "Building Functional Prototypes Using Conductive Inkjet Printing" in IEEE Pervasive Computing, vol. 13, no. 03, pp. 30-38, 2014.

[2] Kipphan, Helmut (ed.): Handbook of Print Media: Technologies and Production Methods. Heidelberg: Springer Verlag, 2001, p. 64.

[3] https://www.siebdruckland.de/Was-ist-Siebdruck, access Oct. 24, 2021.

[4] https://www.pdsinternational.com/printing_information/articles/stencil_making/0604_Its_Only_a_Screen.pdf, access Oct. 24, 2021.

[5] https://www.mpm.co.jp/electronic/eng/silver-nano/line-up.html, access Oct. 24, 2021.

[6] https://circuitscribe.com, access Oct. 24, 2021.

[7] https://www.bareconductive.com/collections/electric-paint, access Oct. 24, 2021.

[8] https://www.adafruit.com/product/1656, access Oct. 24, 2021.

[9] https://media.digikey.com/Photos/Tyco%20Photos/329860.jpg, access Oct. 24, 2021.

[10] Q. Gao, X. Shu and X. Wu, "Deep Restoration of Vintage Photographs From Scanned Halftone Prints," 2019 IEEE/CVF International Conference on Computer Vision (ICCV), 2019, pp. 4119-4128.