Equipment and Materials

- A 3D printer.

  Minimum requirements:

  - A 3D printer with two extruders (“dual extrusion” capability), to print both regular and conductive material.

  Recommended:

  - A *cartesian* 3D printer (as opposed to a *delta* 3D printer), to make printing more consistent throughout the *print volume* and easier to predict in general.

  Nice-to-have’s:

  - A 3D printer with even more than two extruders , to also print “breakaway” or dissolvable material for ‘scaffolding’ prints above the *build plate*.
  - An Ultimaker-brand 3D printer.* All Ultimaker-brand 3D printers are cartesian 3D printers.
    - An *Ultimaker 3* (or *Ultimaker 3 Extended*), as used in our project development.
    - An *Ultimaker S3*, the successor to the *Ultimaker 3*.

  - More than one 3D printer:
    - More than one of the same make & model, to more quickly test print settings, test designs, and create complete devices – get up and running faster.
    - More than one of different models, to try them out and similarly get up and running faster at the cost of less consistency and predictability.

- A spool of regular 3D printing filament, preferably just 250 grams for sensor structures, or to start with for large albeit partially-hollow prints.
  - Easy-to-Print 3D Printer Filaments
  - Flexible 3D Printer Filaments

- A spool of conductive 3D printing filament (e.g., 500 grams of *LulzBot*-brand black 2.85-mm PLA), preferably just 250 grams, which is more than enough.
  - Conductive Easy-to-Print 3D Printer Filaments
  - Conductive Flexible 3D Printer Filaments

- Nice-to-have: A spool of “breakaway” or dissolvable 3D printing filament, preferably just 250 grams, which is more than enough.
  - Structural Support 3D Printer Filaments
  - Ultimaker PVA material: Water-soluble support for complex prints
  - Ultimaker Breakaway material: Easy-to-remove support material for dual extrusion

- Recommended: One or more good-quality crafting/hobby knives with a forward-facing cutting edge (e.g., that of an *X-Acto #18* blade) to help remove prints from the *print bed*.
- Recommended: One or more good-quality crafting/hobby knives with a slanted cutting edge (e.g., that of an *X-Acto #2*, *#11*, *#19*, or *#24* blade) to help remove prints from the *print bed*, and help touch them up afterward.
- Recommended: One or more pairs of tweezers, to help clean the *extruder nozzles* of the 3D printer.
- Recommended: A set of hex keys, to disassemble and reassemble the filament *feeders* before and after cleaning/clearing them.
- Optional: One or more compressed air canisters used for dusting, to clean most of the 3D printer (and workspace) of filament dust and stray pieces, during and after printing.
- Nice-to-have: A shop supply of compressed air, to clean most of the 3D printer (and workspace) of filament dust and stray pieces, during and after printing.

⚠ CAUTION

Caution: Compressed air lines are at very high pressures. Always wear safety goggles when working with a compressed air line. Never point its nozzle at yourself or others. Failure to do so may result in bodily harm.

NOTICE

Note: Compressed air lines are at very high pressures, much higher than that of a compressed air canister. Test their force a meter from the 3D printer first. Failure to do so may damage the more delicate parts of the printer.

- Optional: *ScotchBlue* or similar tape, to form a layer on the *print bed* for making prints stick to it better during fabrication, while making it easier to remove afterward.

* We do not endorse or represent Ultimaker or any of the other brands named in this documentation.