RepRap

Smart Ideas (si)
and
Dumb Mistakes (dm)

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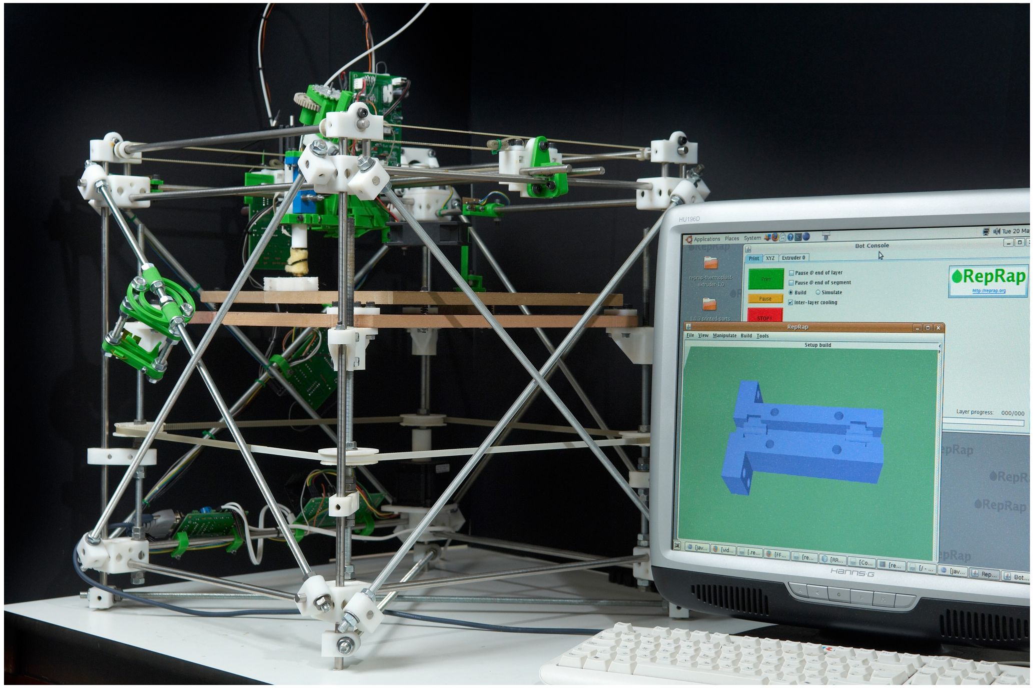


Start with: Social/Economic/Political Specification (si)

Aim: to allow anyone to make what they want for themselves, including the machine that does the making.

1. Free hardware/open-source (si)
2. Distributed at no charge over the net (si)
3. Legal: design copyright under the GPL (si/dm ?)

RepRap

Then: Engineering Specification

1. Working volume: adjustable (si); nominally 300mm x 300mm x 300mm (dm)
2. Working materials: Polycaprolactone and a filler/support (si → dm)
3. Configuration: 3-axis Cartesian drive using stepper motors (si)
4. Line and space: 0.5mm and about 0.2mm (si)
5. Feature size: about 2mm (si)
6. Positioning accuracy: 0.1 mm (si)
7. Layer thickness: adjustable, but nominally 0.4mm (si)
8. Computer interface: RS232 (dm → USB)
9. Material handling: Two fixed material extruders, user exchangeable (si)
10. Power supply needed: 6A max, 3A continuous at 12V DC (si)
11. Driving computer: Microsoft Windows, Linux, Unix, or Mac (si)
12. Dimensions: adjustable; nominally 600 mm x 520 mm x 650 mm high (si)
13. Weight: about 15 Kg (si)

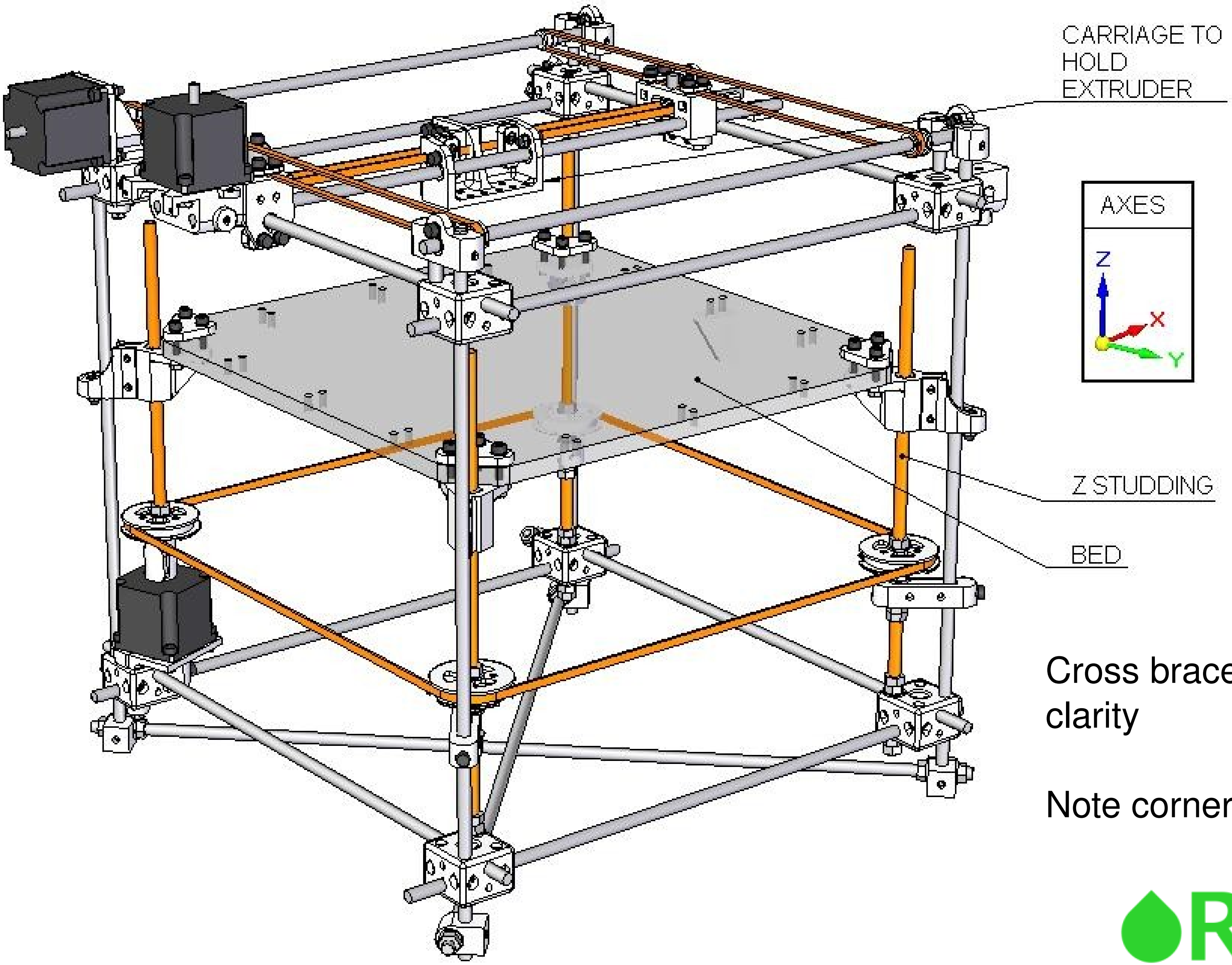
RepRap

How easy is it to change things as you go along?

1. Software - easy
2. Electronics – not too difficult
3. Mechanics - difficult

So: early on, think hardest abut the mechanics, and get them as good as you can. (si)

Mechanics



Cross braces omitted for clarity

Note corner blocks

RepRap

Mechanics

Metric, not English (si)

Standardise (si)

Check *global* availability (si)

1. Hardware shop materials (si)
2. Threads: M8, M5, M3 (si)
3. 8 mm threaded rod (si)
4. 8 mm smooth rod (dm)
5. Don't dismiss wood (especially MDF) (si)
6. Make jigs (si)

RepRap

Mechanics

Design Frame of Mind:

If you can, make each part solve lots of problems (si)

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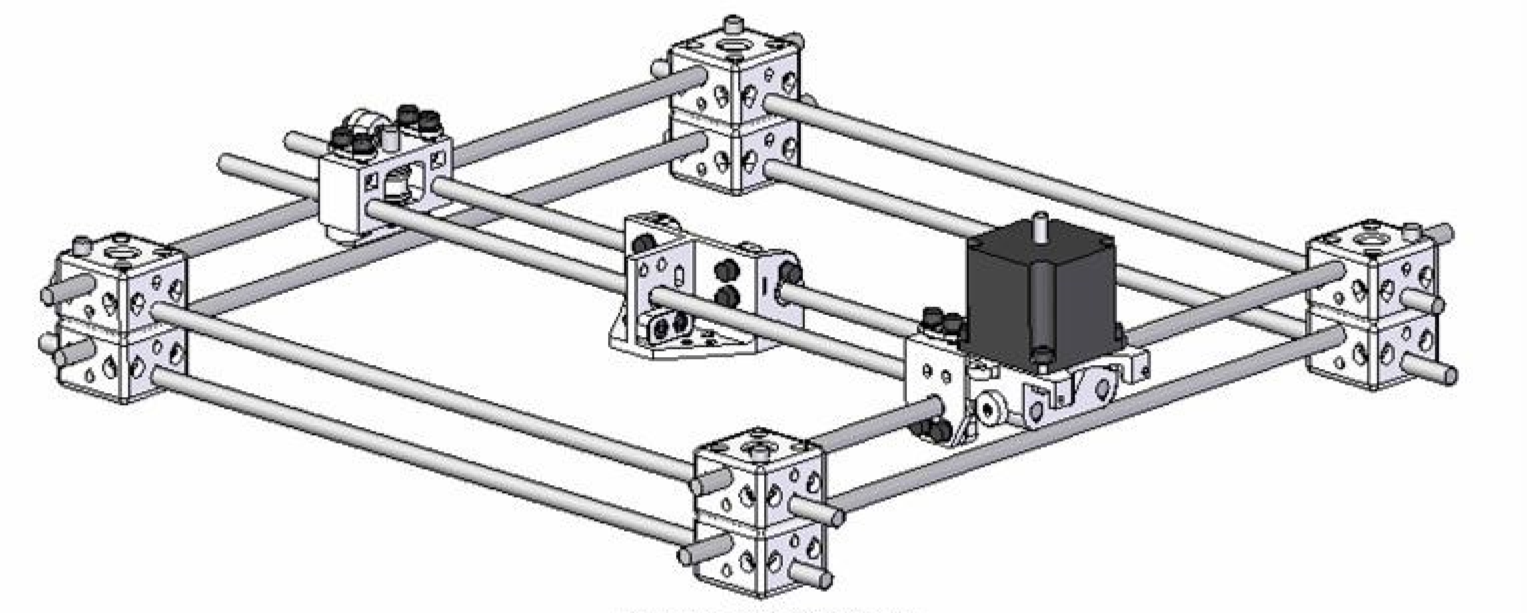
Mechanics

Design Frame of Mind:

Remember that you have to put it together and to take it apart... ***Lots*** of times... (si)

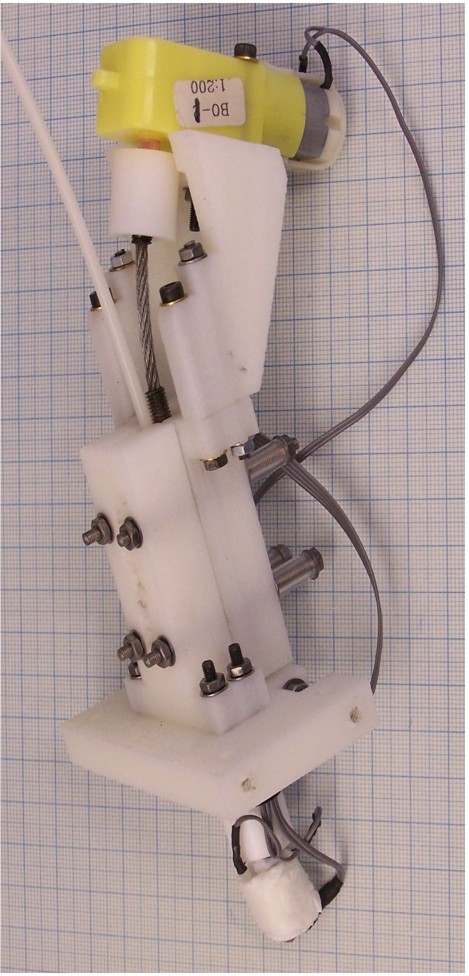


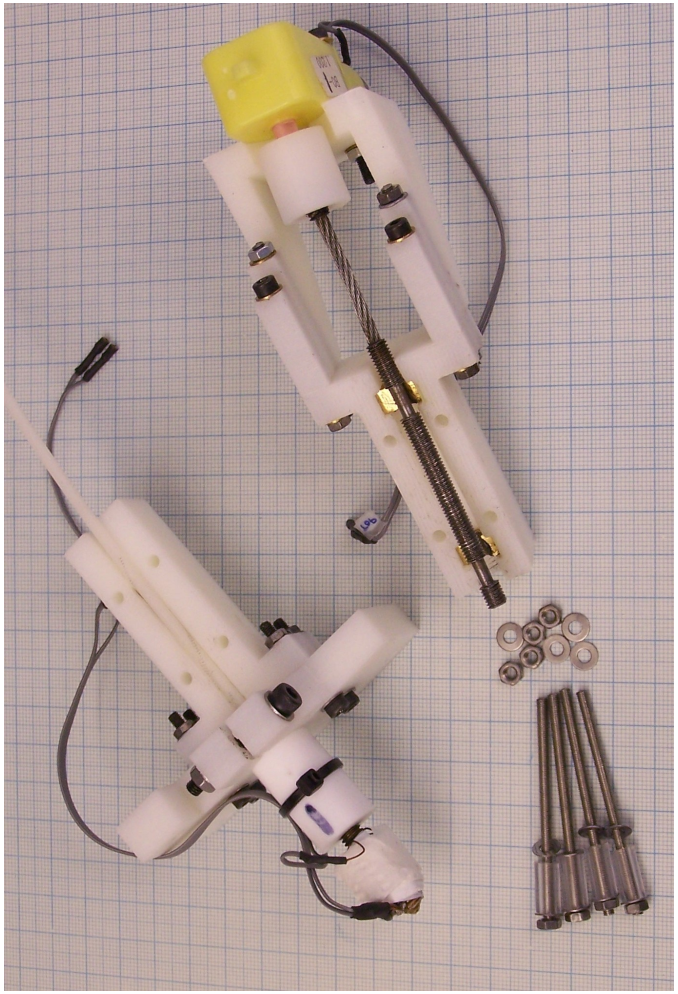
DATUM/TOP CORNER

Mechanics

The Version 1 Extruder

1. Screw drive (si)
2. Geared DC motor (dm)
3. PTFE insulation (si)
4. Brass barrel (si)
5. Nichrome heater (si)
6. Thermistor (si/dm)
7. Flexible drive (dm)





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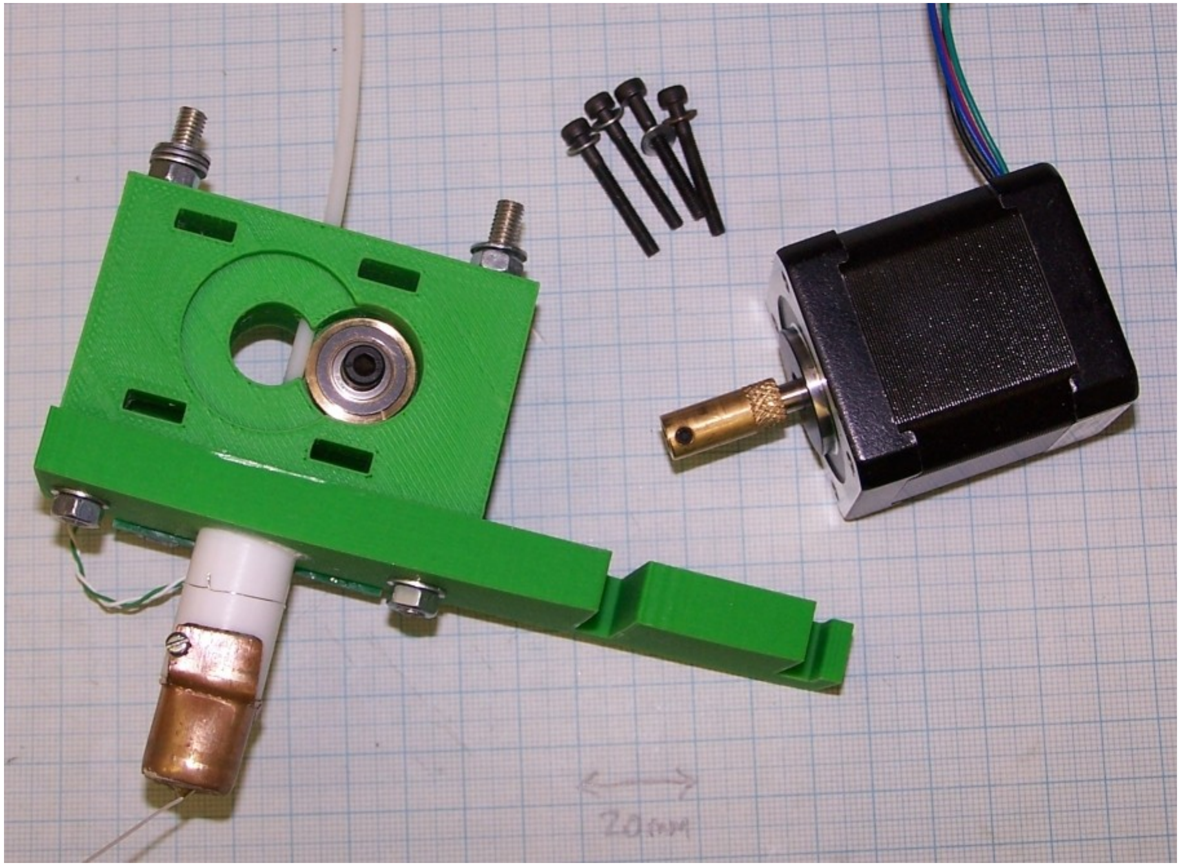
Mechanics

The Version 2 Extruder

1. Direct drive (si)
2. Stepper motor (si)
3. Same head (si)
4. Fewer parts (si)
5. More controllable (si)
6. Easy set-up (si)
7. Thermocouple (si/dm)



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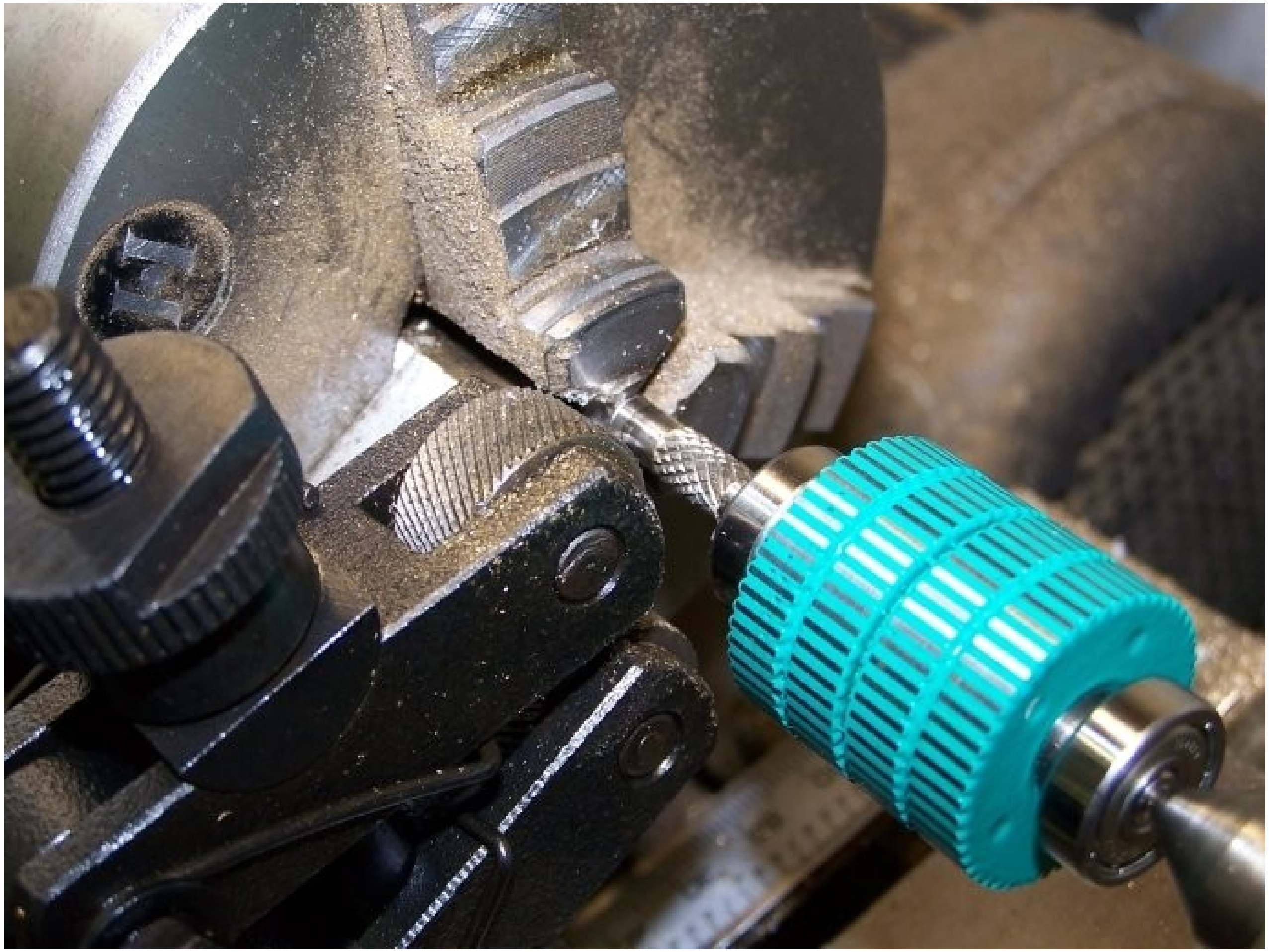
Mechanics

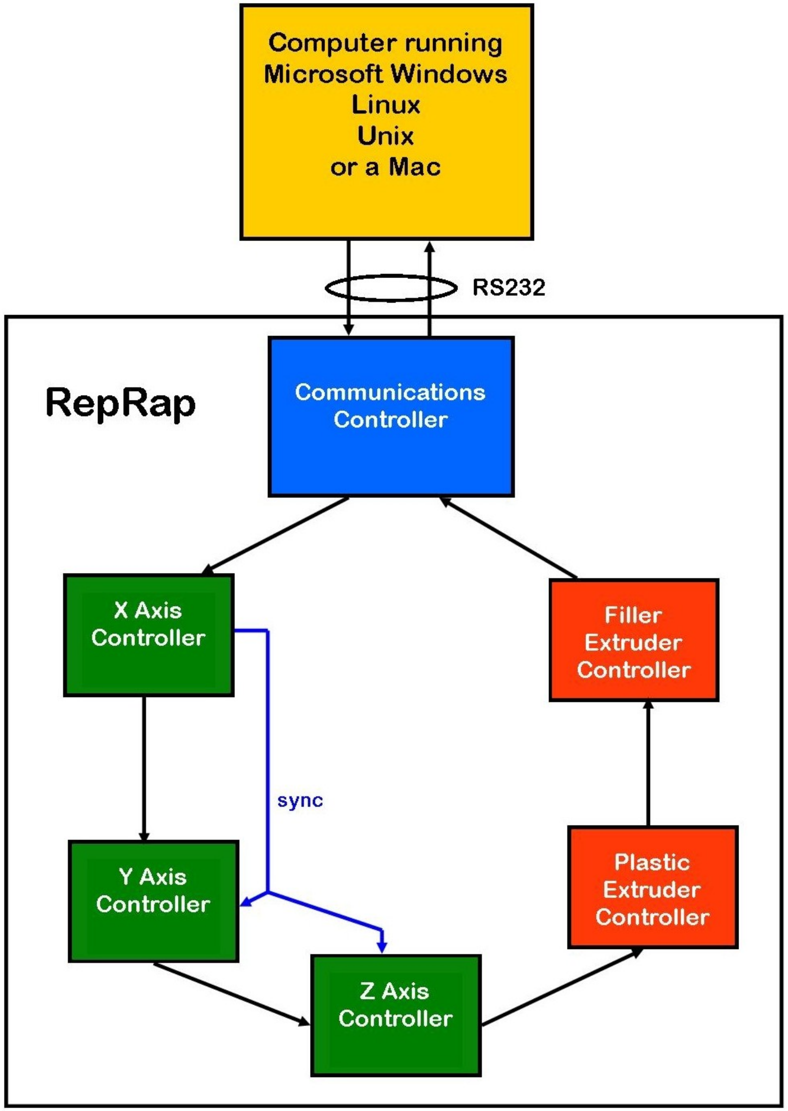
Knurl the stepper shaft directly



Electronics

Generation 1

1. Internal network (si)
2. RS232 (dm)
3. Universal PCB (si)
4. PIC 16F648A (dm)
5. SDCC (dm)
6. Single 12V supply (si)
7. XYZ: steppers (si)
8. Extruder: DC servo (dm)



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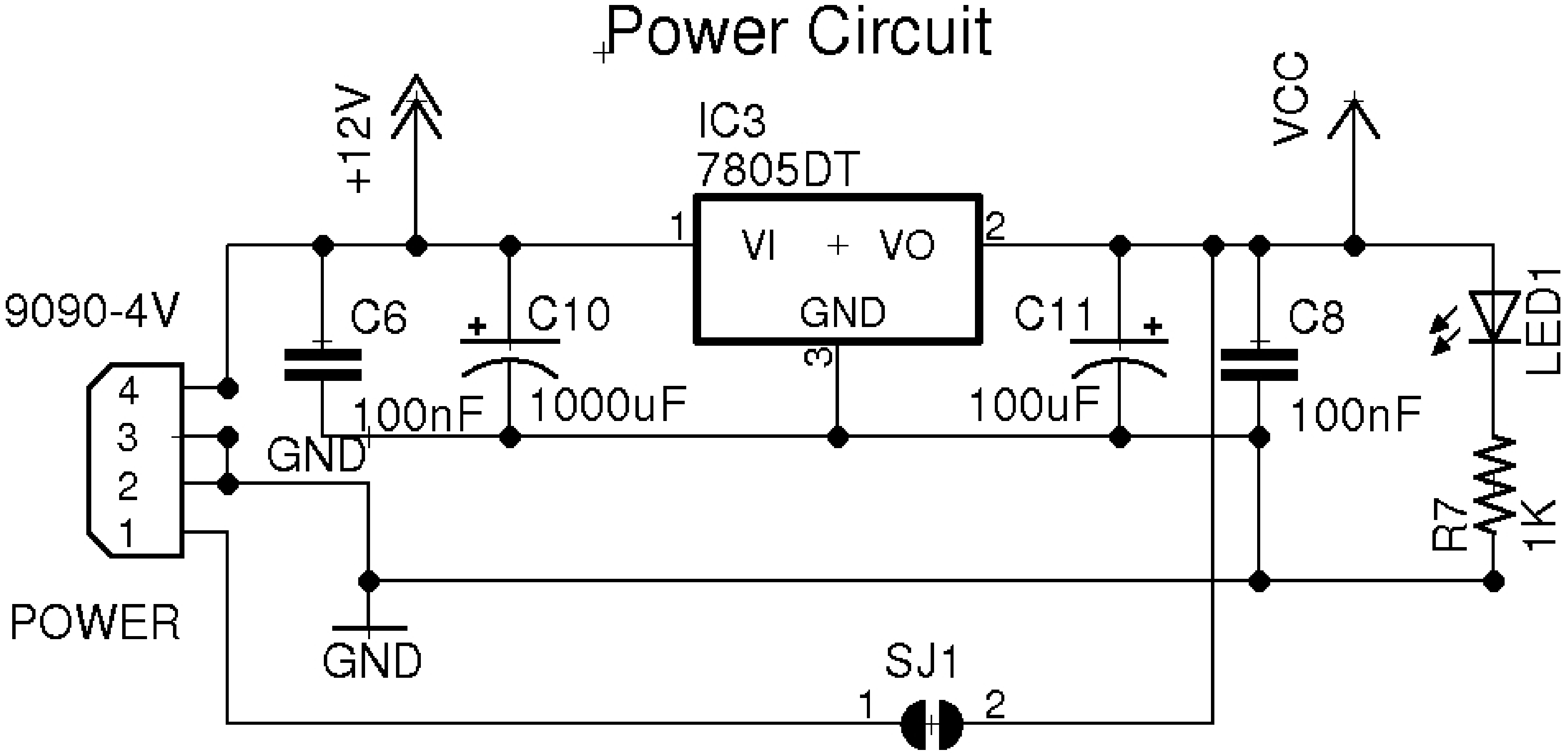
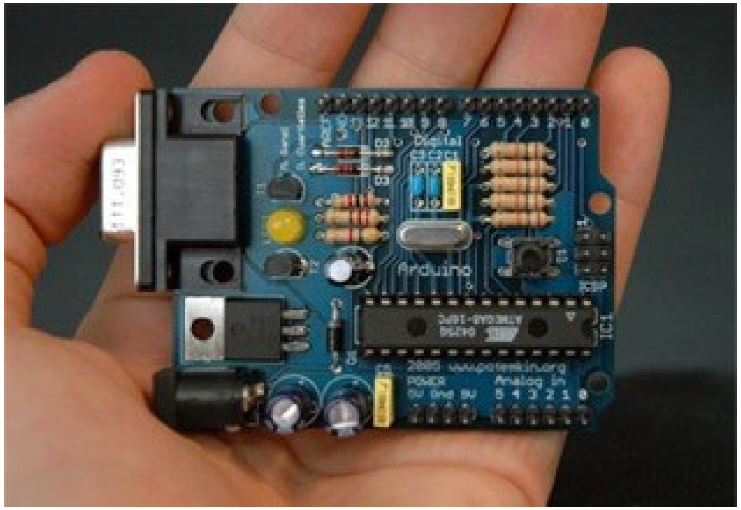
Electronics



Electronics

Generation 2.1

Arduino



1. Rock solid compiler (si)
2. Someone else does the work (si)
3. ATMEGA168 (si)
4. Only just enough pins (dm)
5. Only just enough memory (dm)
6. No internal network (dm)
7. G-codes from host (si)

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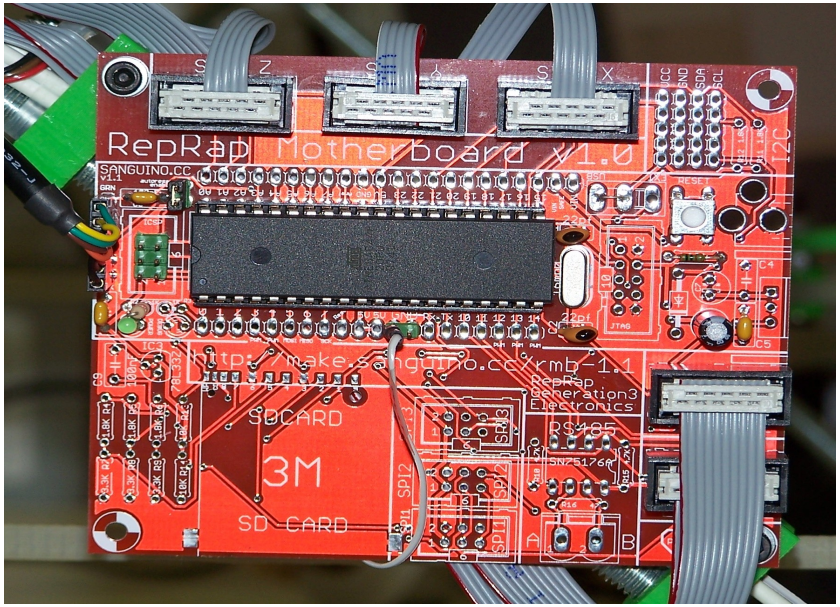
Electronics

Generation 2.2

Sanguino



1. Arduino development environment (si)
2. ATMEGA644P (si)
3. Plenty of pins; plenty of memory (si)
4. No internal network (dm)

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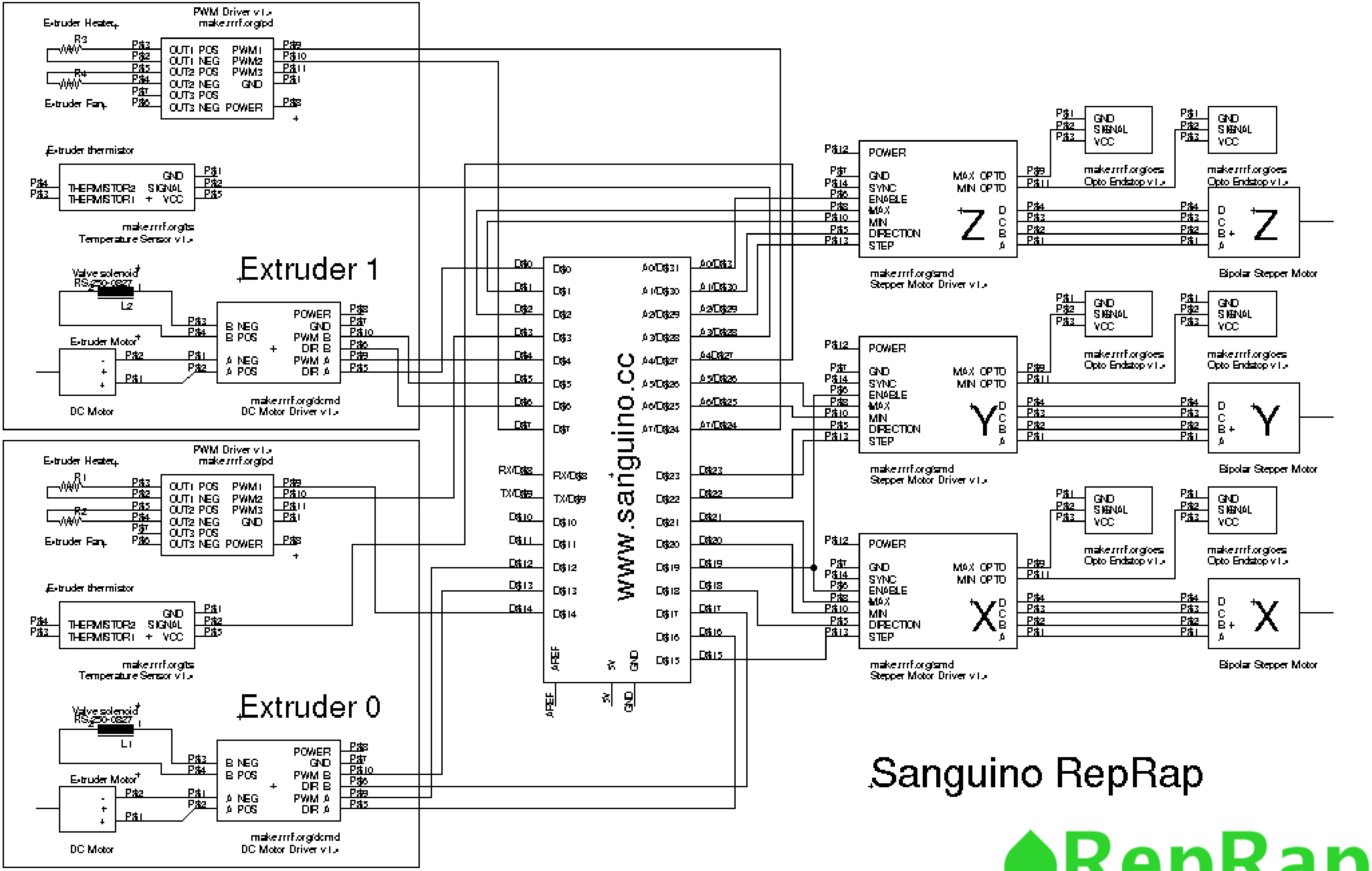
Electronics



Sanguino RepRap

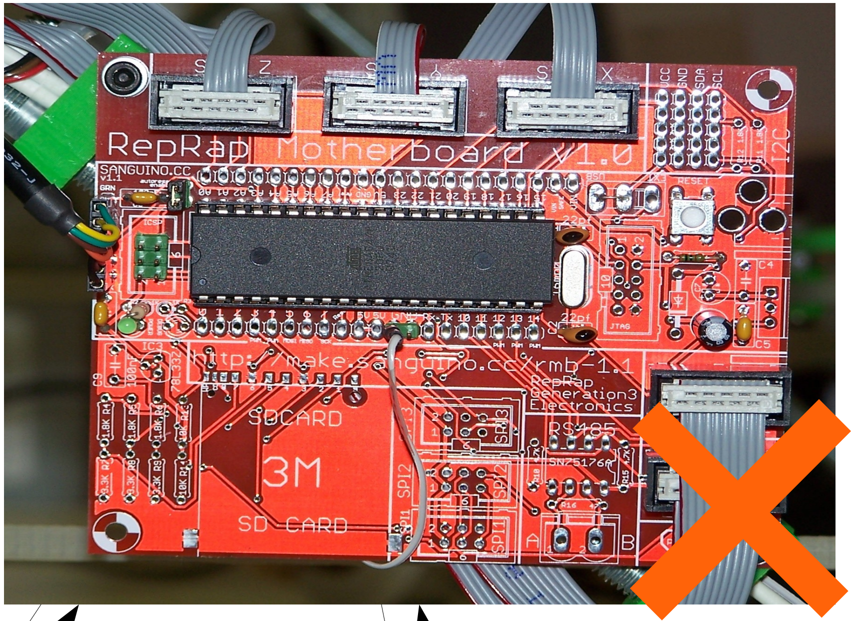
RepRap

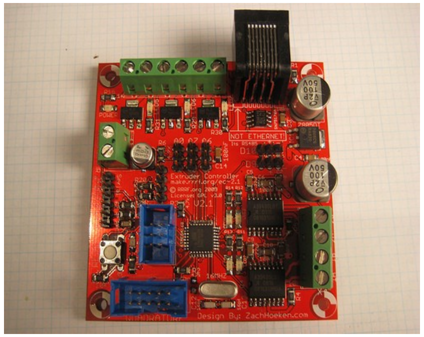
Electronics

Generation 3 (near future)

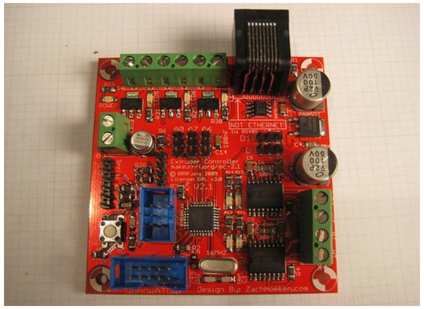
Sanguino

Plus RS485 network

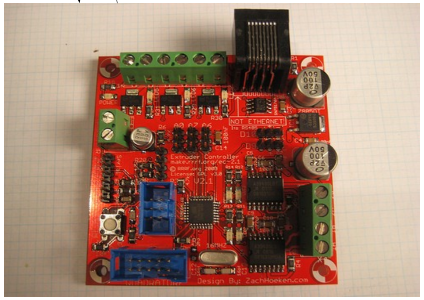

RepRap Motherboard v1.0
SANGUINO.CC
http://make.sanguino.cc/rmb-1.1
RepRap Generation3 Electronics
SDCARD
3M
SD CARD
RS485



Extruder 1



Extruder 2



Extruder 3

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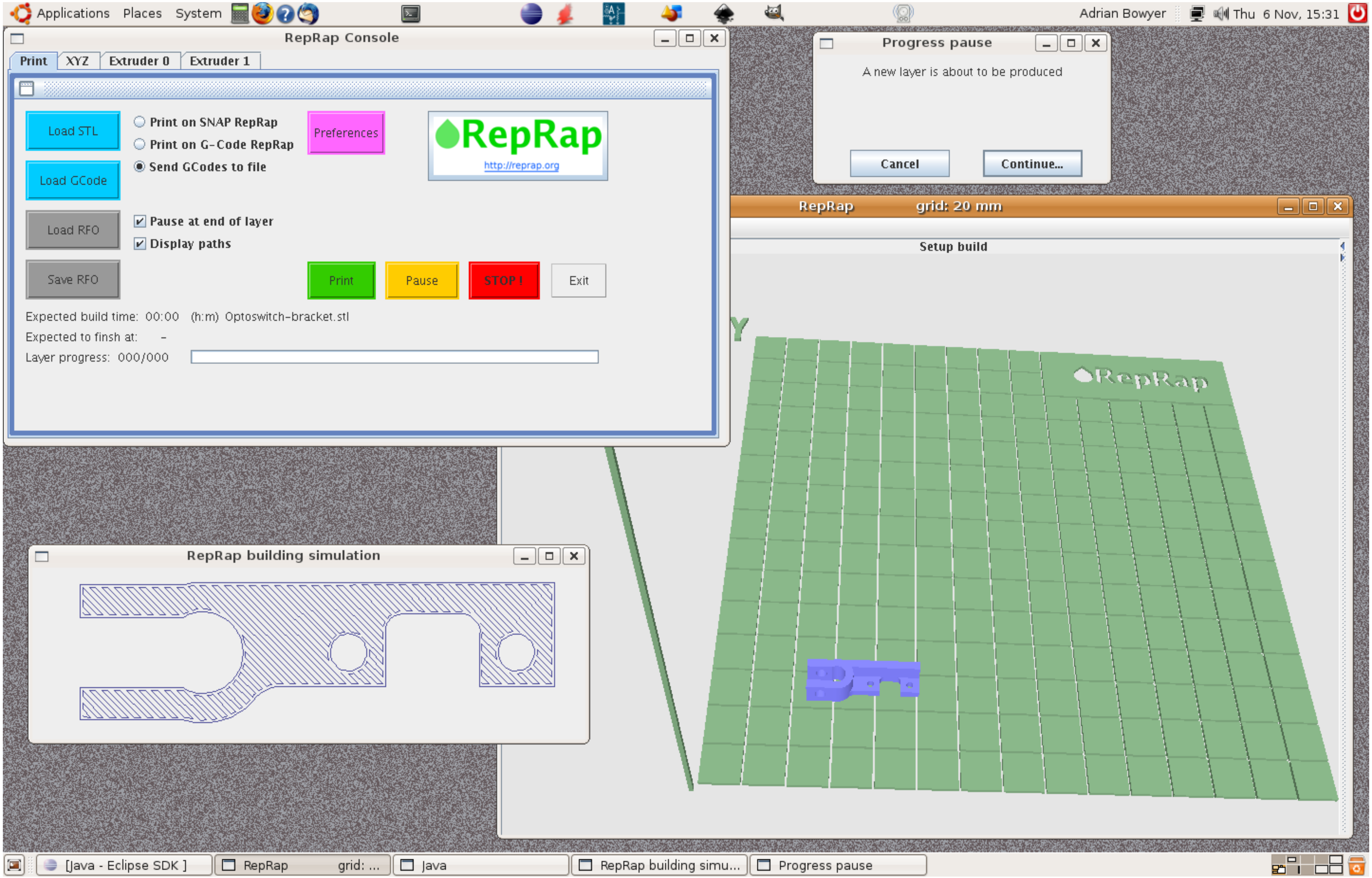
Software



○ Print on SNAP RepRap

○ Print on G-Code RepRap

● Send GCodes to file

☑ Pause at end of layer

☑ Display paths

Expected build time: 00:00 (h:m) Optoswitch-bracket.stl

Expected to finsh at: -

Layer progress: 000/000

A new layer is about to be produced

On the host: Java

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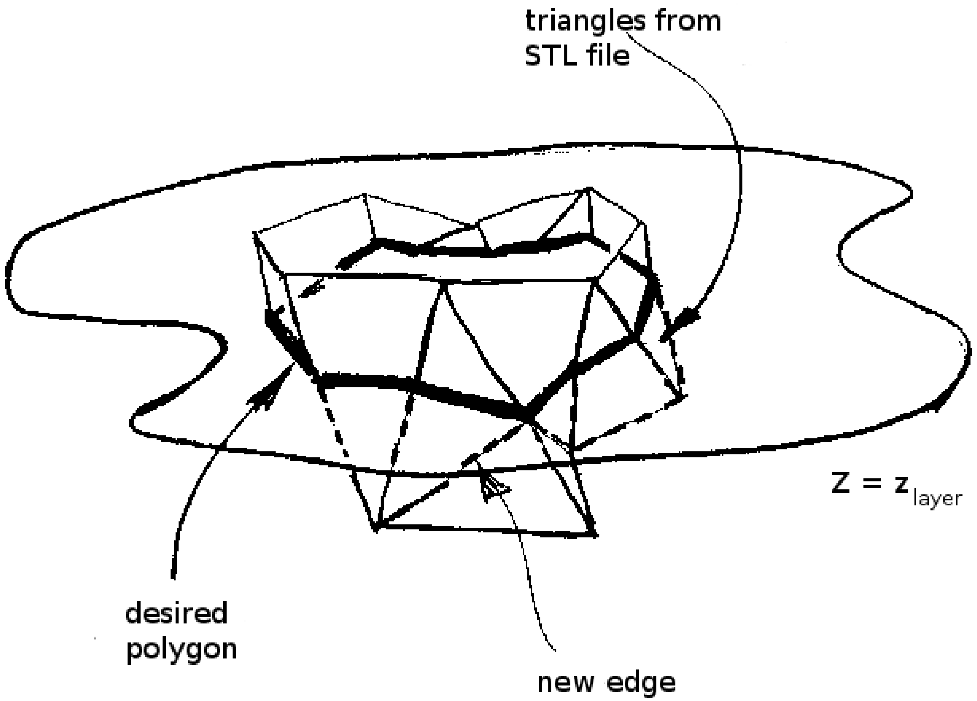
Software

Input data: STL files



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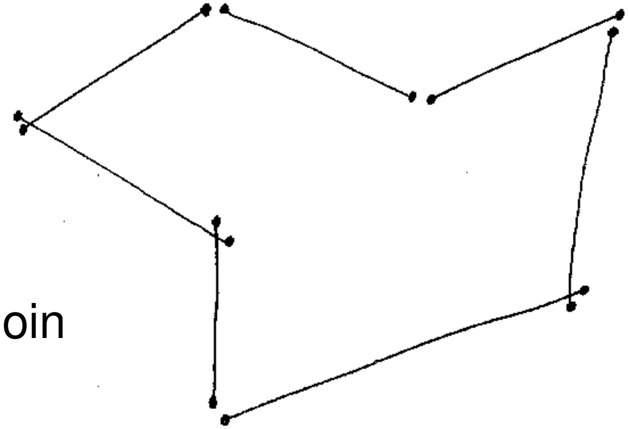
Software

Turning slices into sense

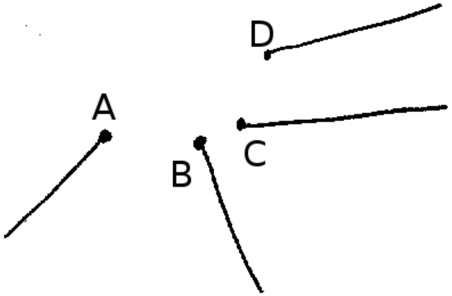
1



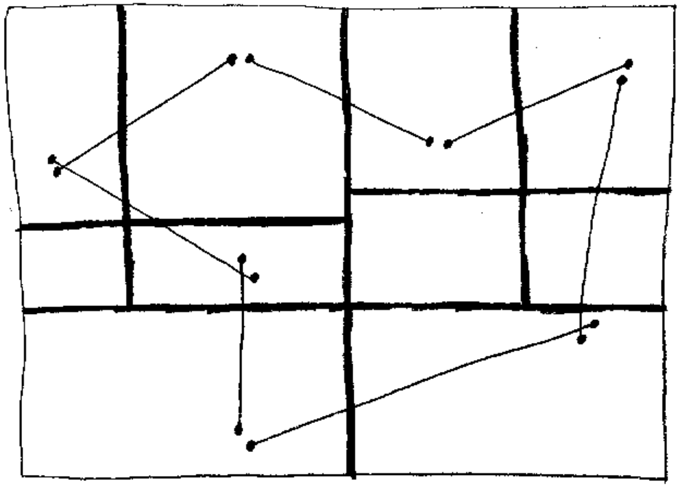
Easy – join the dots

2

But...

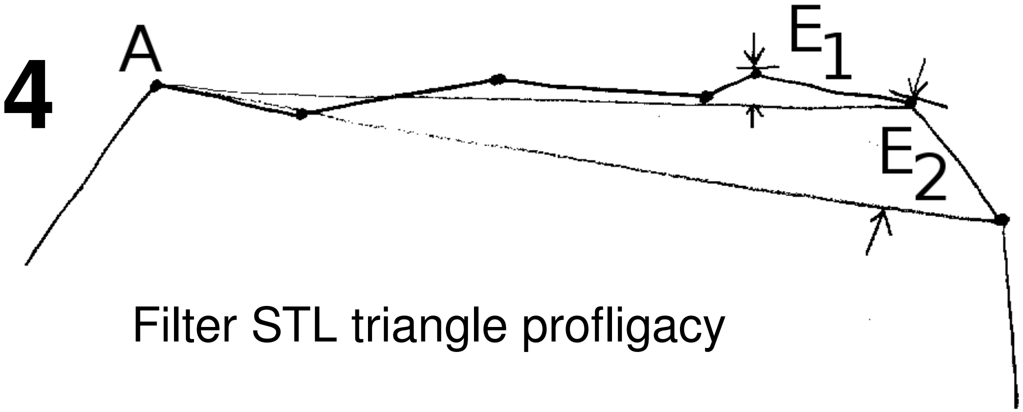


3



Make a global problem local

4



Filter STL triangle profligacy

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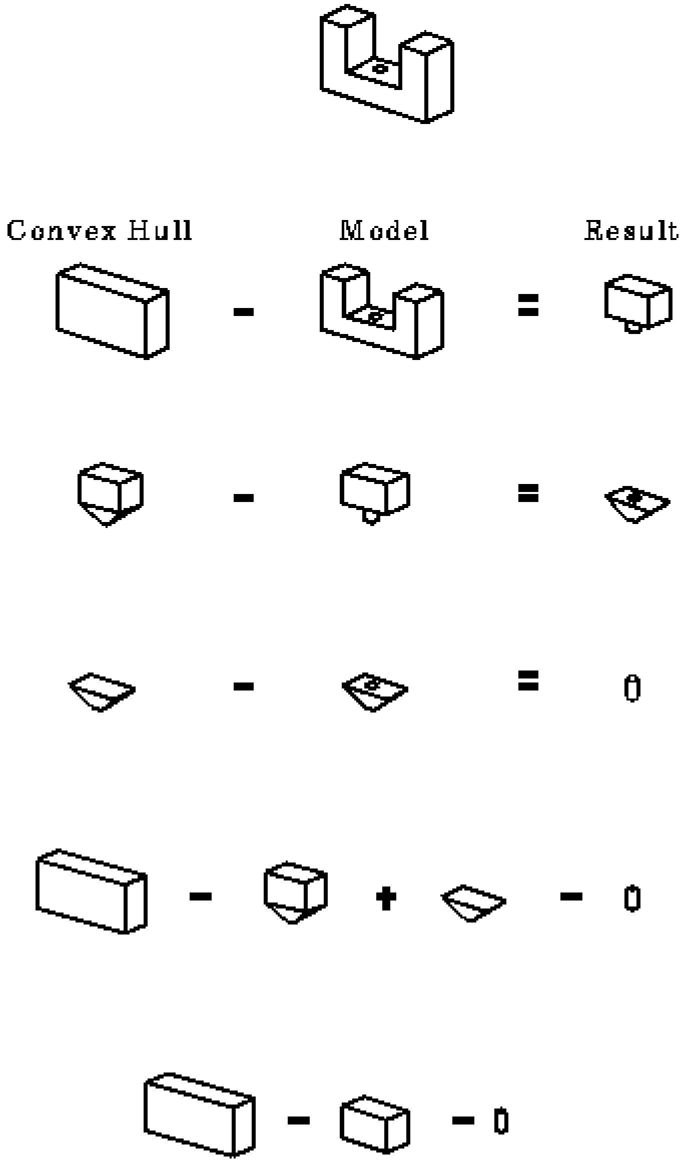
Software

Convert to CSG



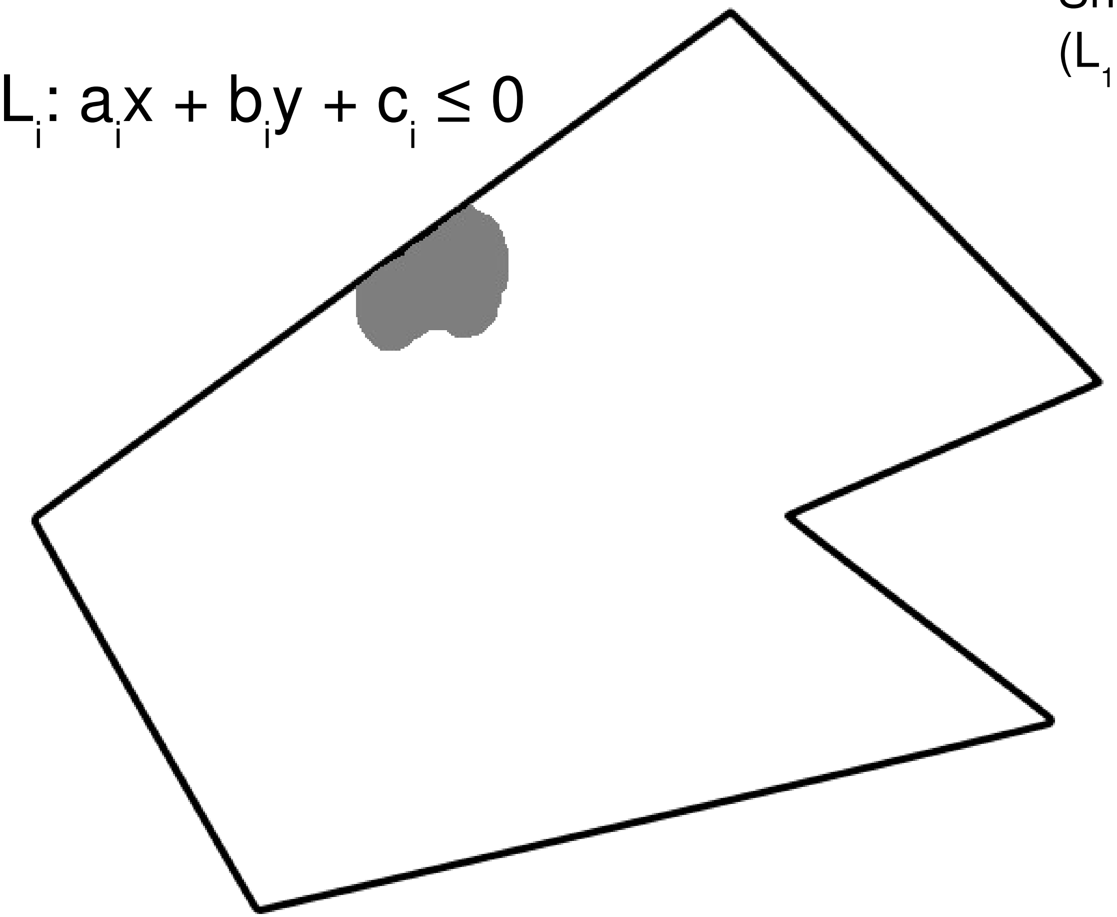
Tony Woo's Alternating Sum of Volumes Algorithm

(but in 2D, obviously)

RepRap

Software

CSG Polygons



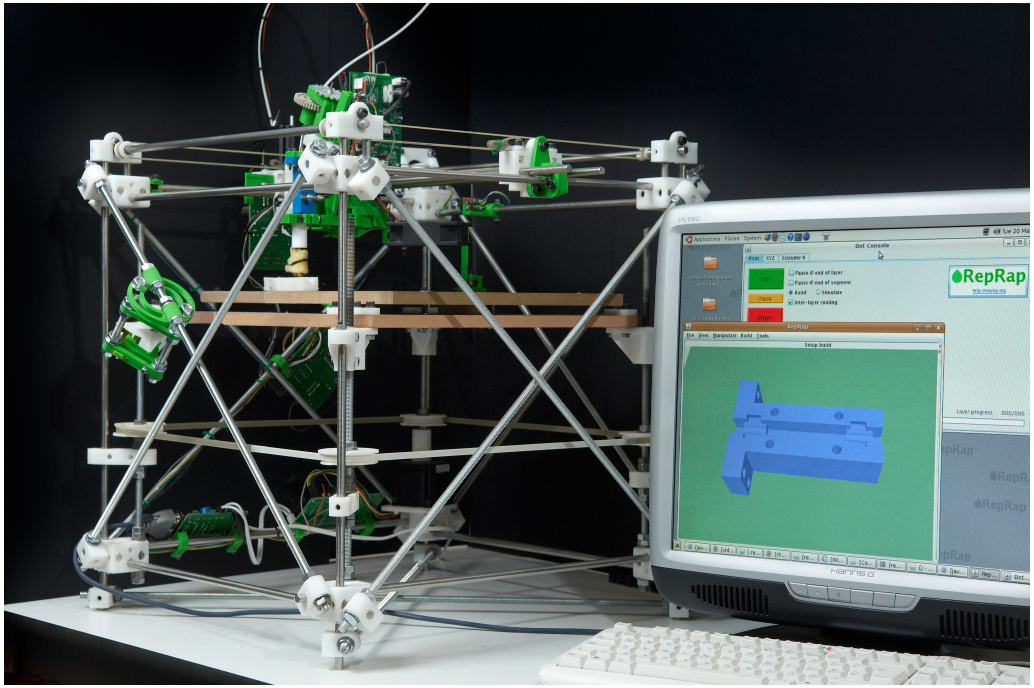
L_i: $a_ix + b_iy + c_i \le 0$

Shape:
$(L_1 \wedge L_2 \wedge L_3 \wedge L_4) \wedge (L_5 \cup L_6)$

1. Always valid (si)
2. Offsets trivial (si)
3. Combinations trivial (si)
4. Line intersection trivial (si)
5. Simplification hard (dm)
6. Non-local (dm)

Conclusion

1. We did some smart things (si)
2. We did a few dumb things (dm)
3. It works... (si)



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