

**RepRap & repsnapper ...**  
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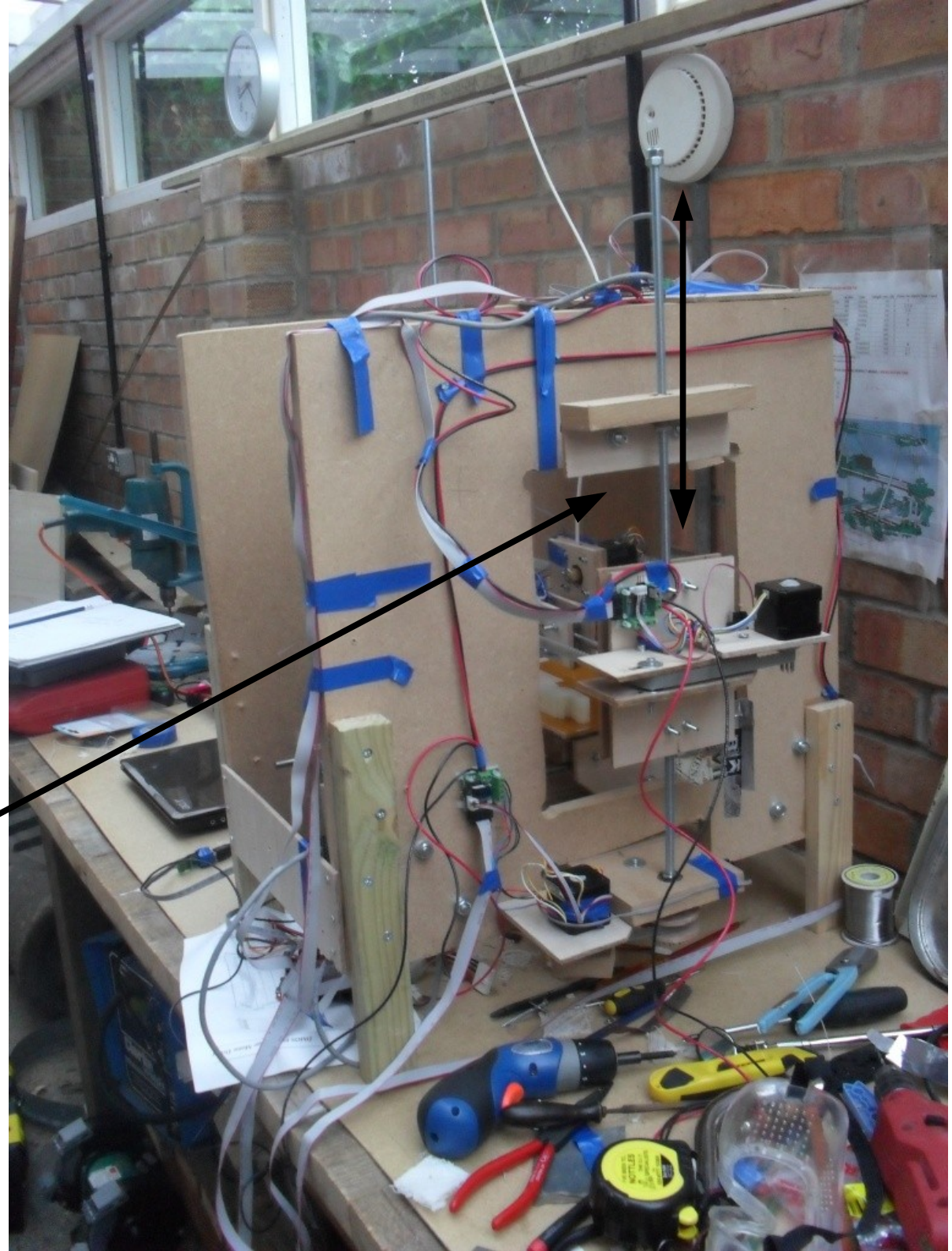


# Replicating Rapid Prototyper

- It prints itself
  - how do you print the first one?
  - Hand-tools + wood + gears + [ extruder ]
  - Reasonably accurate: sub-mm precision
- It has software to control it
  - Software written by mechanical engineers
  - Serial protocol: no flow control & buffer mgmt
  - C++ / curious Arduino based control software

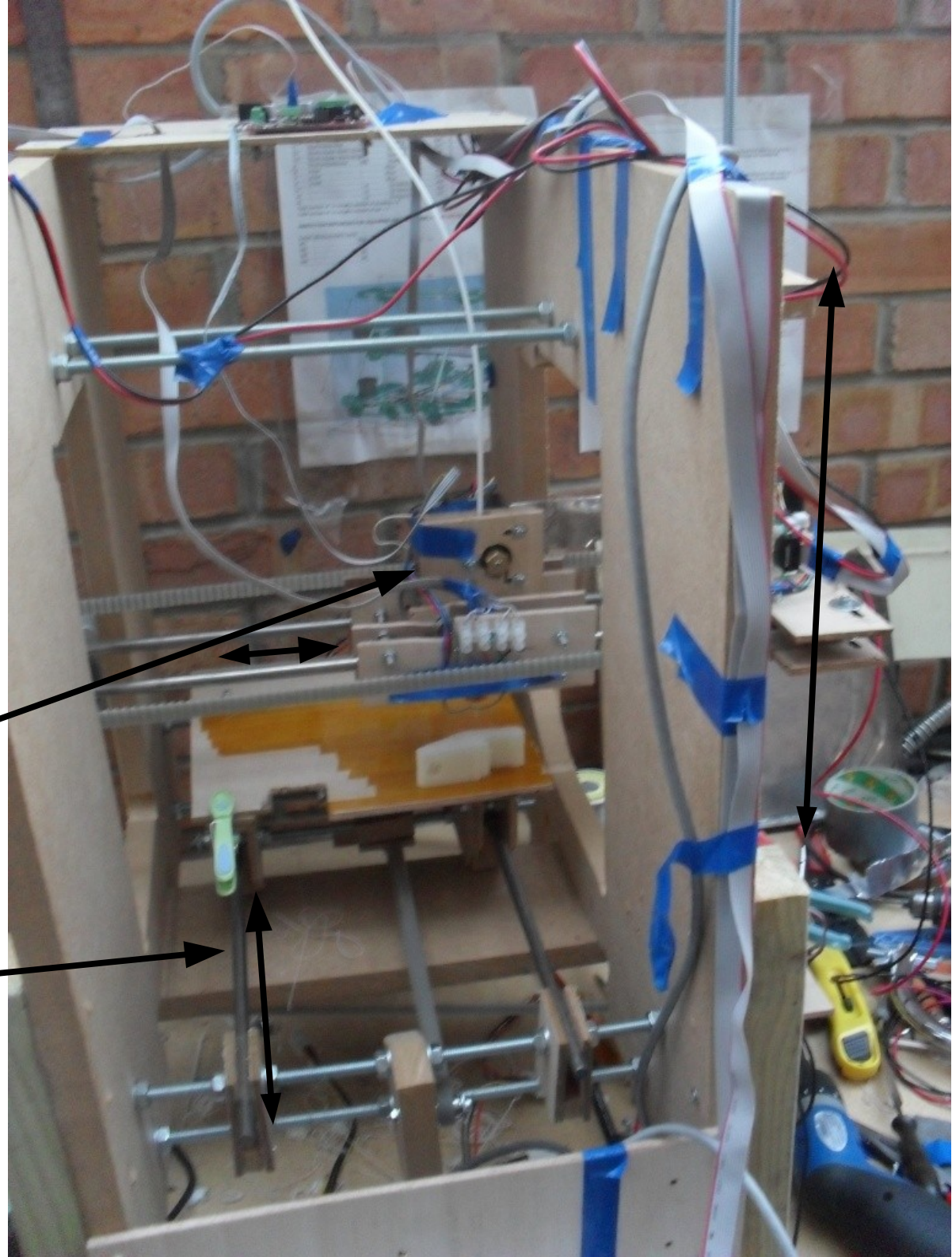
# rep-strap

- Based on Mendel
- Un-documented
- Steppers provide the precision
- Z axis: vertical driven by studding



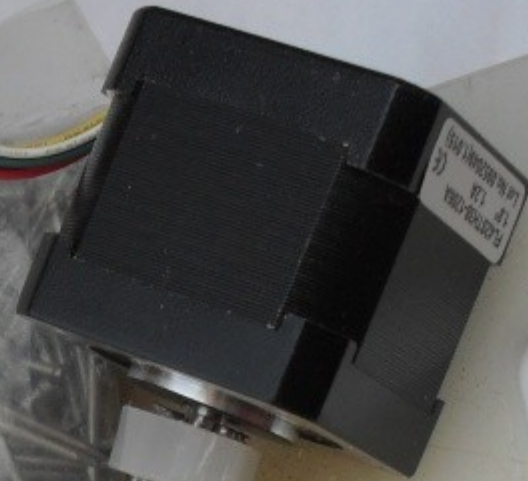
# rep-strap

- Based on Mendel
- Un-documented
- Steppers provide the precision
- X axis carriage extrudes plastic
- Y axis moves build platform
- Both belt driven



# Gears are hard:

Borrowed the wife's chopping block for some hard nylon.





Pin wheel  
z axis



Coat hanger  
Notice the string problem:



Beer Bottle opener.

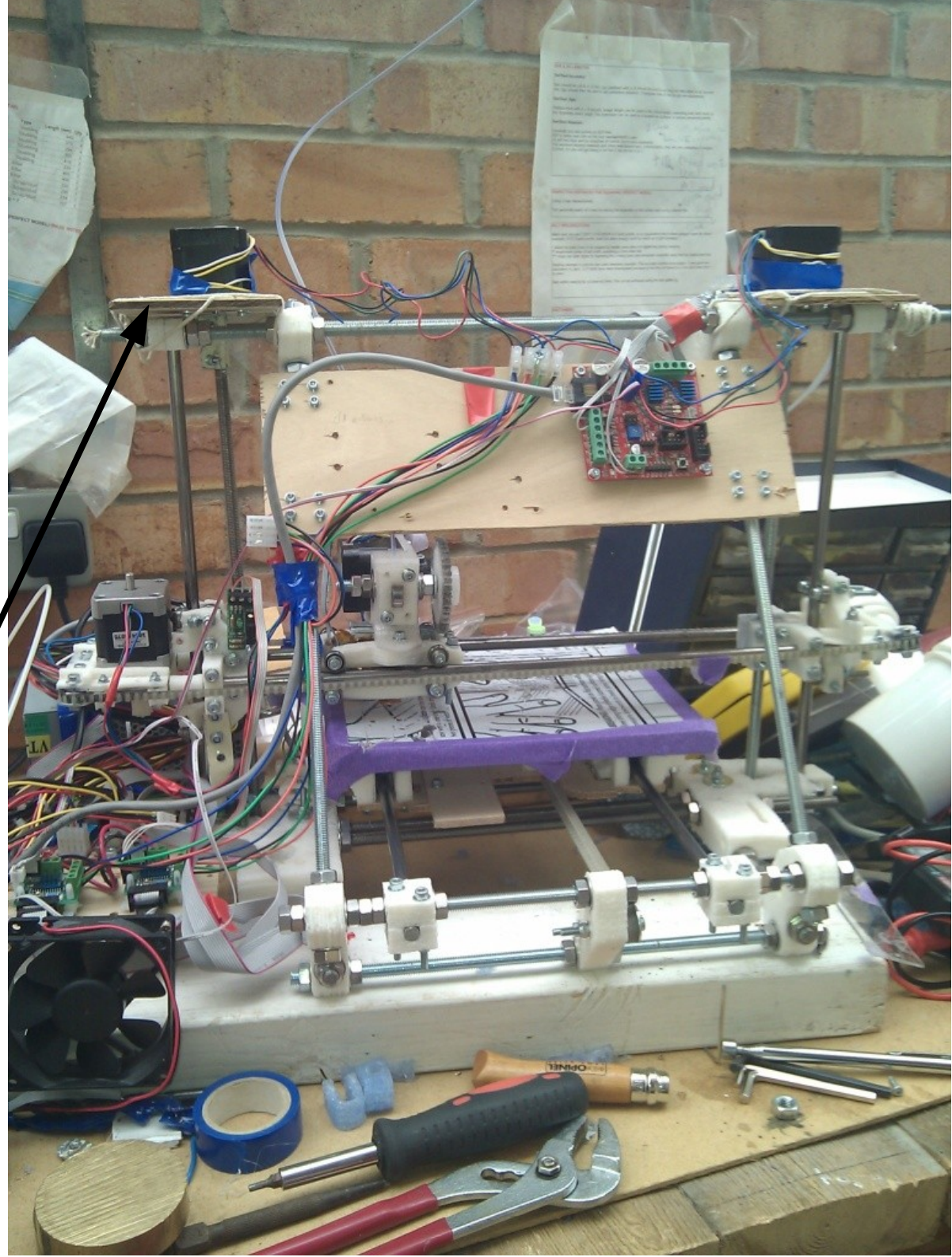
# Next print: a real Mendel

- Very complicated
- Tons of fixings
- Lots of little ABS bits to print out
- Hideous warping problems from repstrap ...



# Next print: a real Mendel

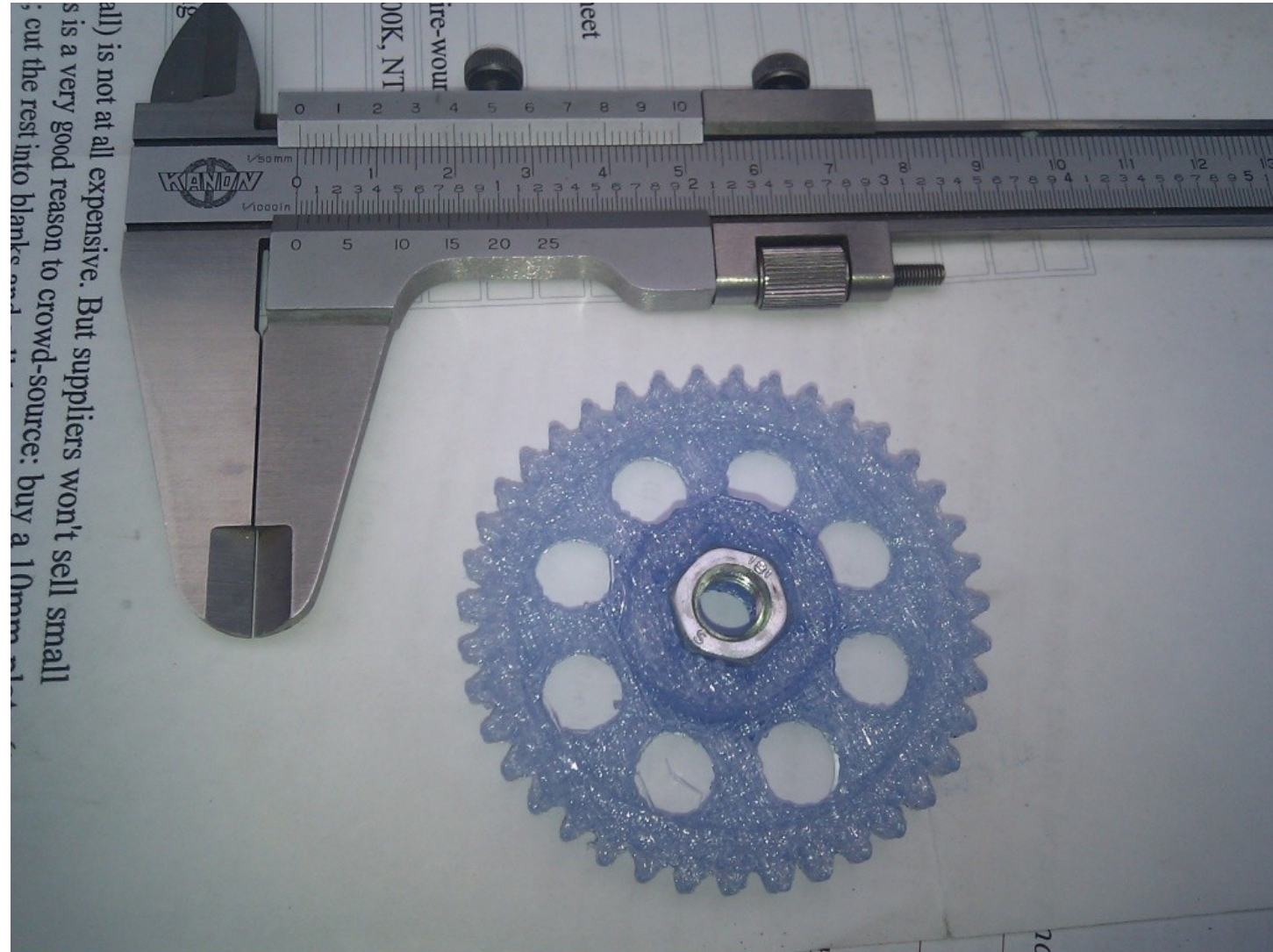
- Electronics trivial in comparison.
- Geared extruder a necessity for printing PLA
- Import misc. Prusa features to fix:





# Print quality considerably better:

- Now printing in PLA: a tough bio-plastic from corn-starch
- Reliability much improved with Mendel.



# Print(ing) Prusa Mendel:

- Prusa: recommended Mendel to build:
- Far fewer components
  - 3 bearings vs. 50+
  - Printable on one mendel bed.
  - Easier to assemble
  - Etc.



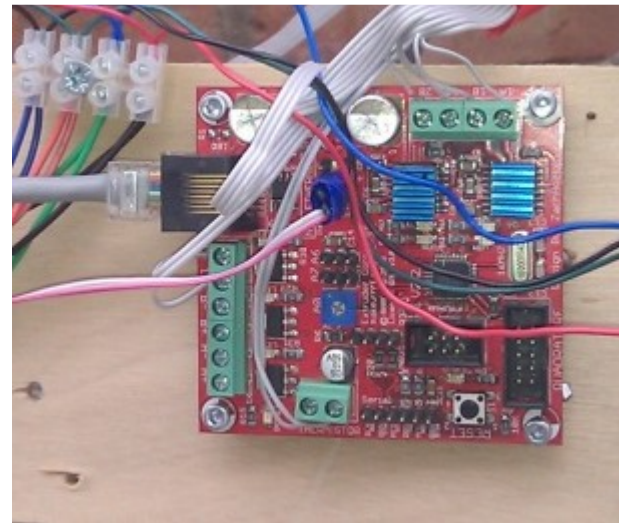
# Electronics ...

- Initially quite complicated:

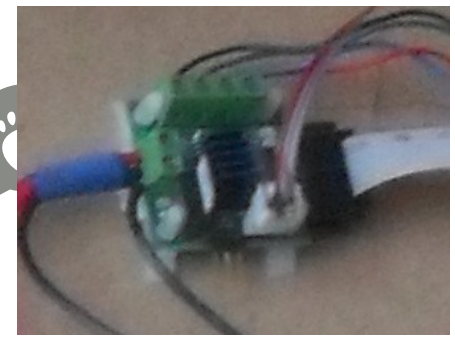
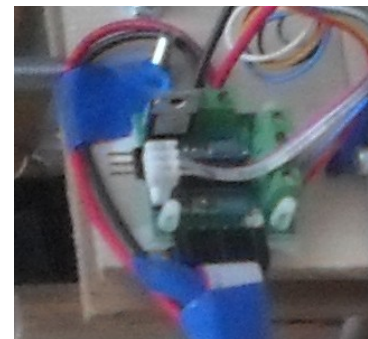
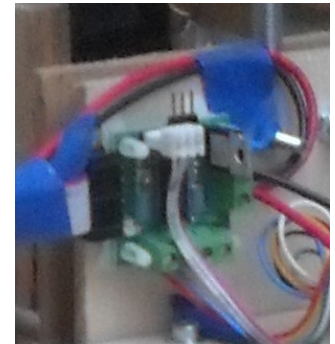
Main controller



Extruder controller

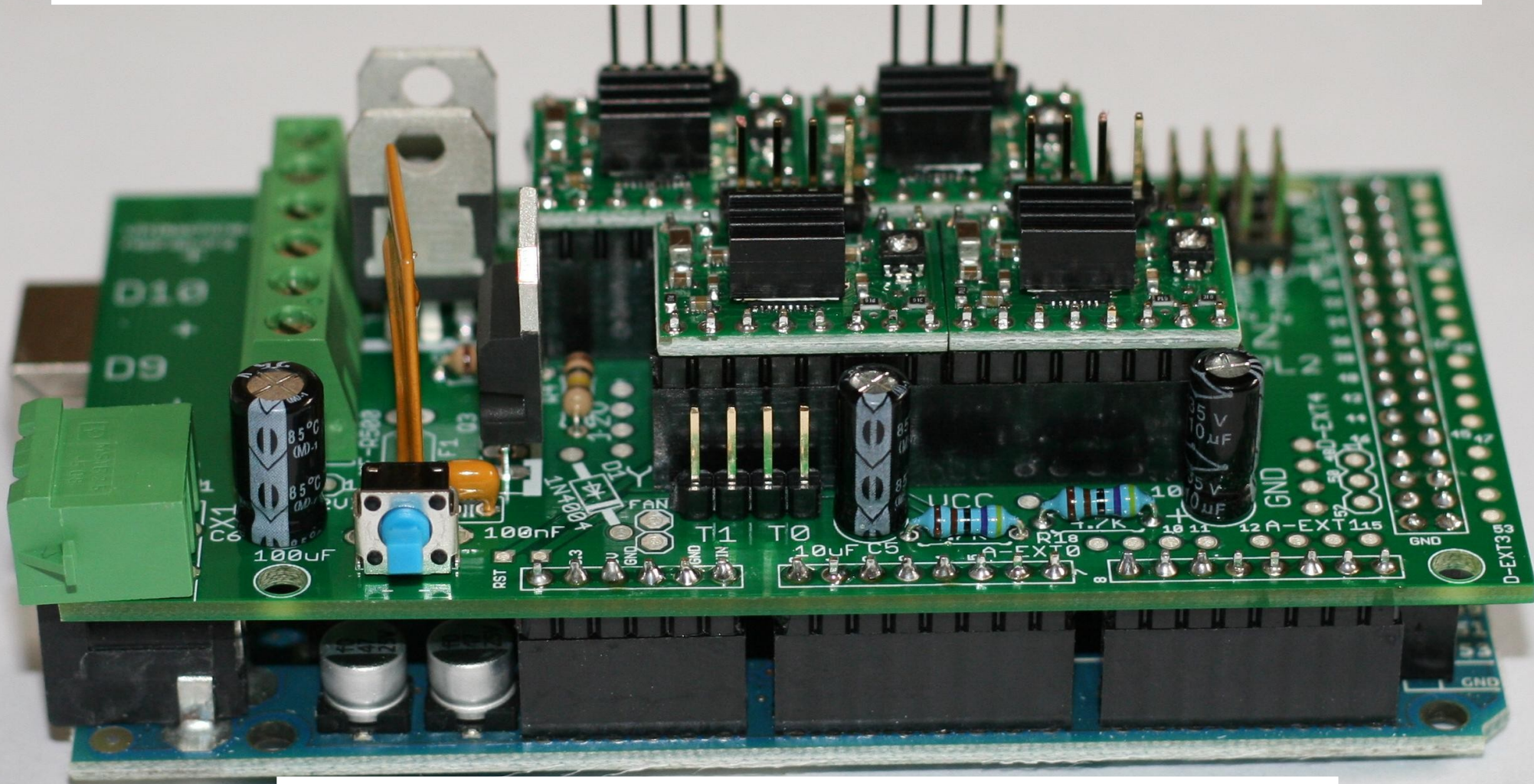


4 Stepper Drivers



# Now a simple Arduino + shield

RAMPS 'Shield' board plugs in on top: ~complete



Standard Arduino board underneath

# The Software ...

- All existing control software is Java
  - evilly unpleasant, terrible native platform integration, performance also poor
  - (but the problems are hard)
- Rendering to GCode Java or Python – also slow.
- RepSnapper: the solution
  - Native C++, Gtk-- (ported from FLTK)
  - Almost entirely re-written by yours truly.

File Edit Help

Connect Port: /dev/ttyUSB0 Pause Print Home All Power On Kick

Load a Model Load Machine Code Printer Controls Comms

Load STL

Convert to GCode

Save STL

Delete

Duplicate

▼ Unsaved file

▼ Unnamed object

mendelplate.stl

# Load and render STL files ....

Object Rotation

Auto Rotate

X

Y

Z

Object Translation

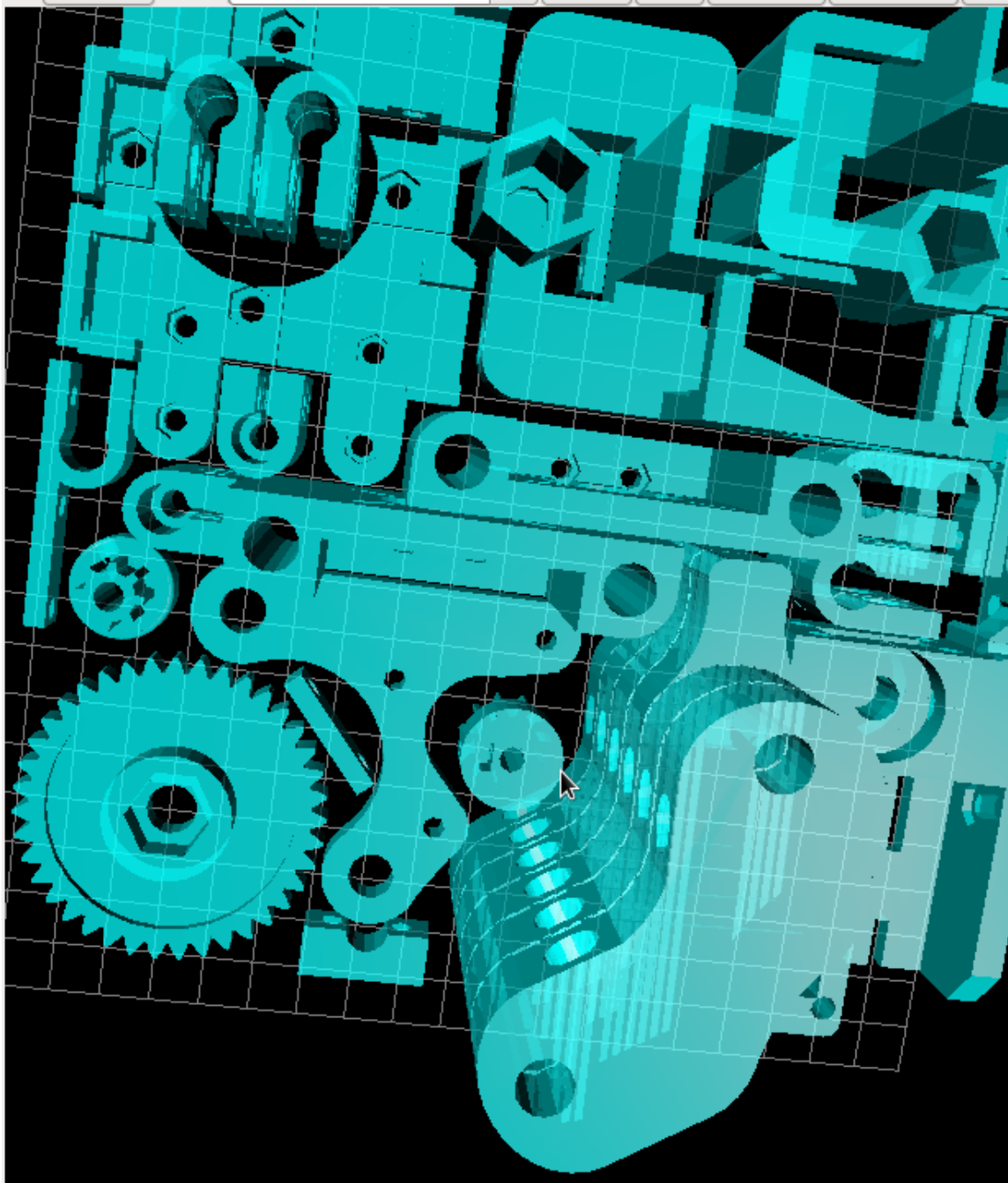
X 0.0

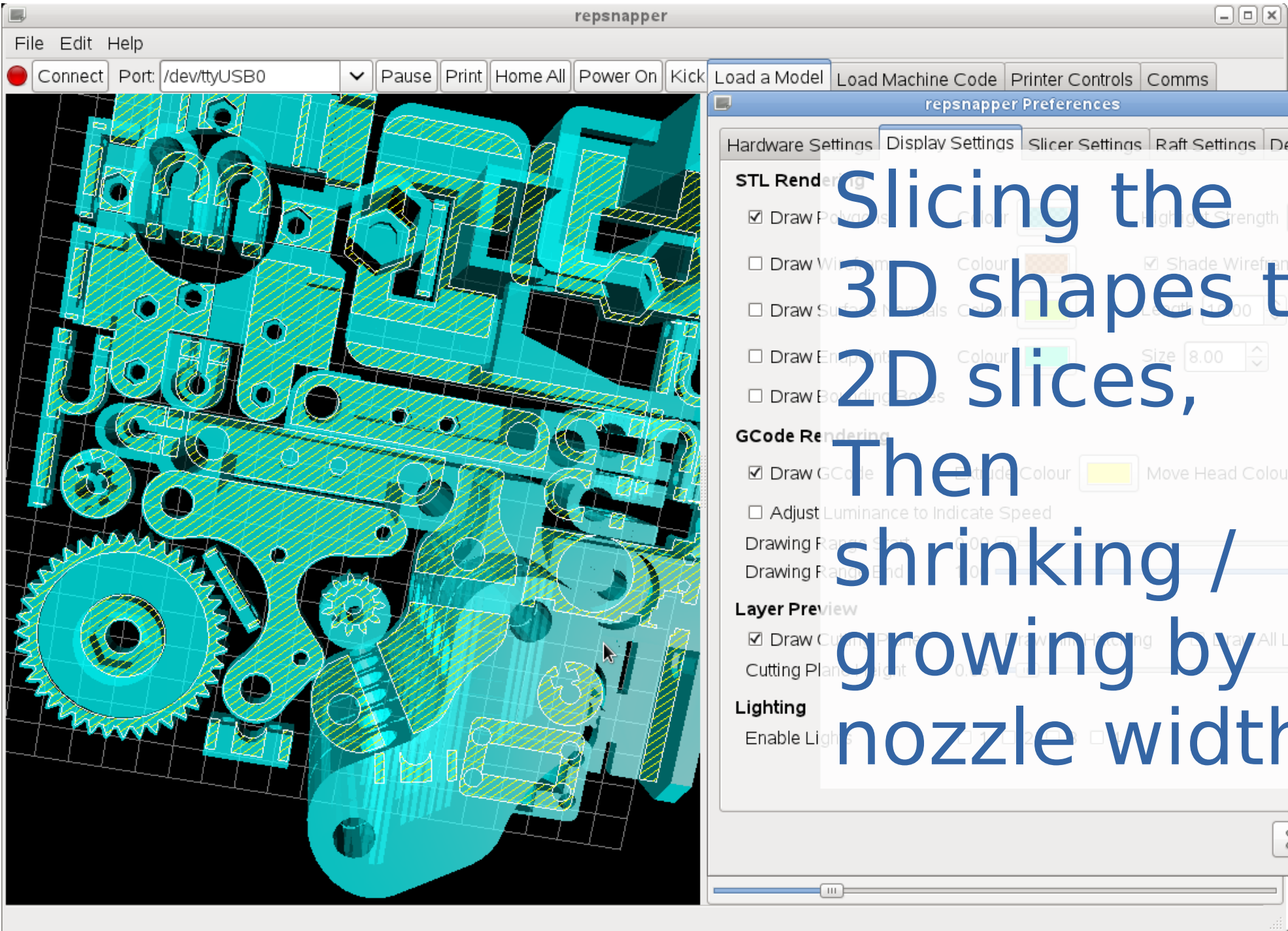
Y 0.0

Z 0.0

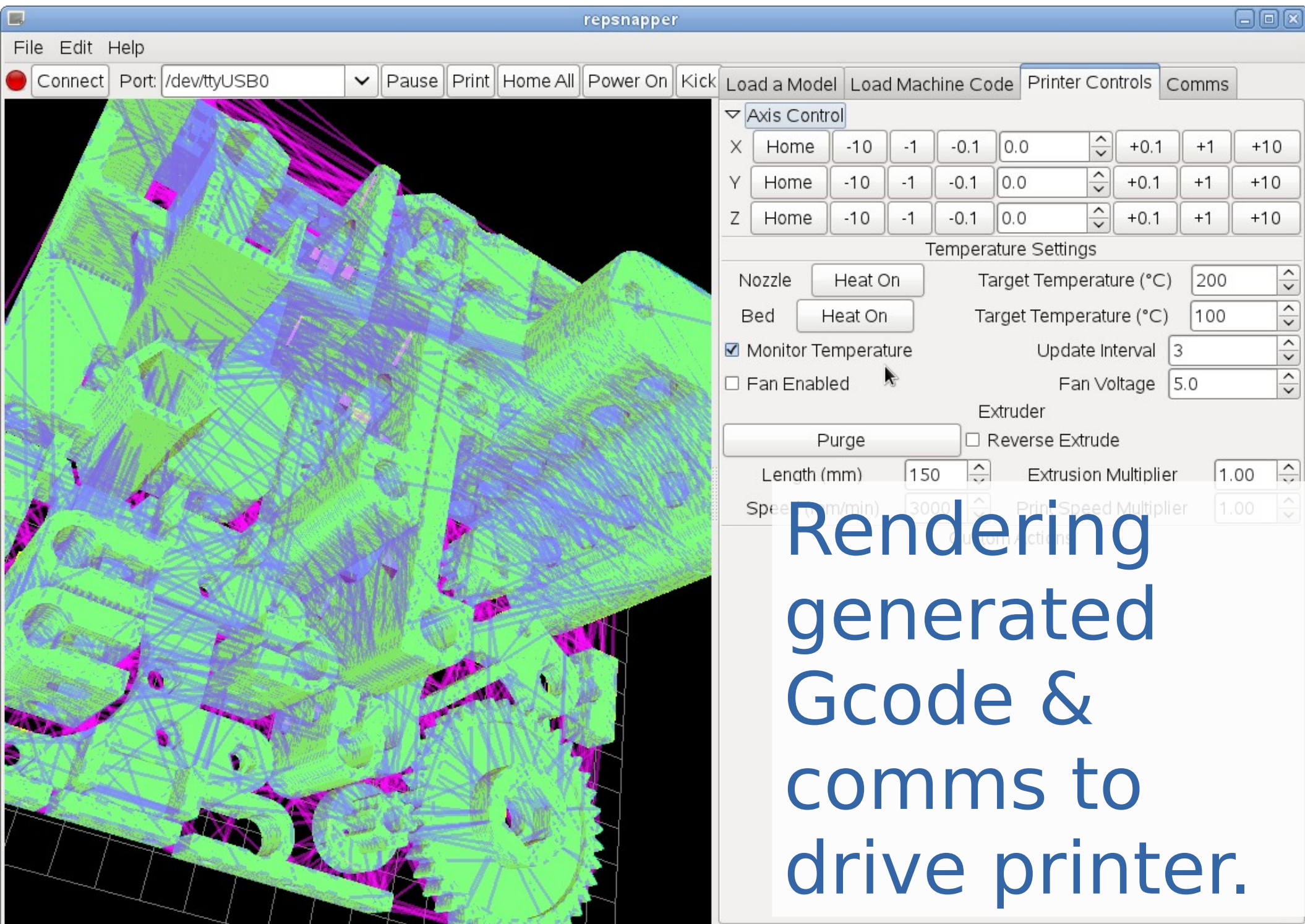
Object Scaling

1.00





Slicing the  
3D shapes to  
2D slices,  
Then  
shrinking /  
growing by  
nozzle width.



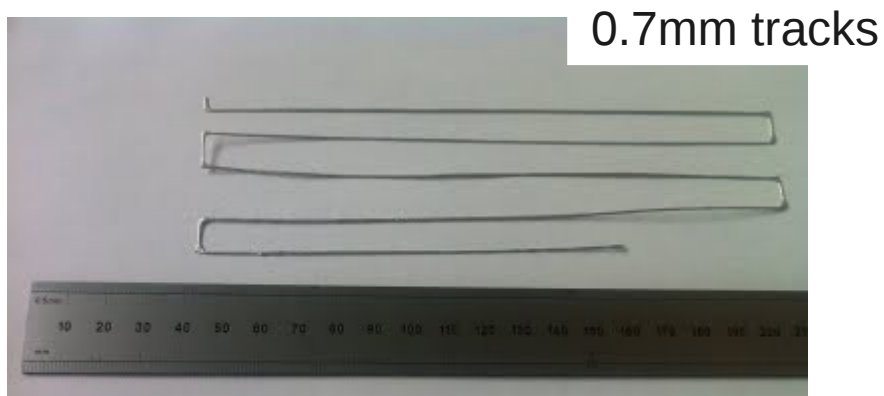


# Software love required ...

- dynamic detection / hot-plug of USB printers
- accelerated slicing / shrinking / fill
  - algorithms really lame, input files dirty too.
  - improved filling algorithms, multi-dimension modelling etc.
- standard for multi-object / multi-material
  - .zip file with XML meta-data + STLs ?
- good multi-extruder / multi-material support
- only characteristic settings + calibration flow
- Binary Controller code tweak-ability + up-load

# Finally ... Rhys Jones' metals ...

- Electrical machine / PCBs need metal
- Custom low temp. Tin, Bismuth, Indium alloy



Unfortunately dissolves metal nozzle at well below its melting point.

- The future from here ...
- Credits: all @ Bath, Prague & wider community
- <http://www.reprap.org/>

Ergo:  
requires an  
anodised  
nozzle to fix:



Images from: <http://blog.reprap.org/2011/06/new-approach-to-printing-metals.html>