What I did on my Holiday

Weekend Fab8NZ Un-conference
+ Monday Fab8NZ Academic Symposium
+ HOPE9 Audio DVD (1 of 2)

Reece Arnott 27/09/2012

My Expectations

- “FAB8NZ is the 2012 annual international Fab Lab event which gathers field practitioners and laboratory researchers from the Fab Lab network and beyond, for a week of hands-on workshops and a one day academic symposium on the principles and applications of digital fabrication.
- FAB8NZ will be hosted by The College of Creative Arts at Massey University, in conjunction with the Centre for Bits and Atoms at MIT, The Fab Lab Network and the Affect Research Centre, from 22-28 August in Wellington, New Zealand.” - From the Fab8NZ website
- Ok, MIT Centre for Bits and Atoms, Neil Gershenfeld, big name, very cool!
- But, if its a week long conference, why only 3 days for the general public? Are they being elitist?

What I skipped over

- “The annual fab meeting is a combination of symposium, workshops and AGM for the fab lab network. It is an opportunity for the network to come together and share best practice, as well as plan for the future.”
- FabLabs grew out of academia and so have that mindset of dividing people into teacher/student/public and needing to do administrative stuff to make sure everyone has the same standards.
- Its just more inward focused than the Reprap project which is more obviously seeking outsiders to be involved.

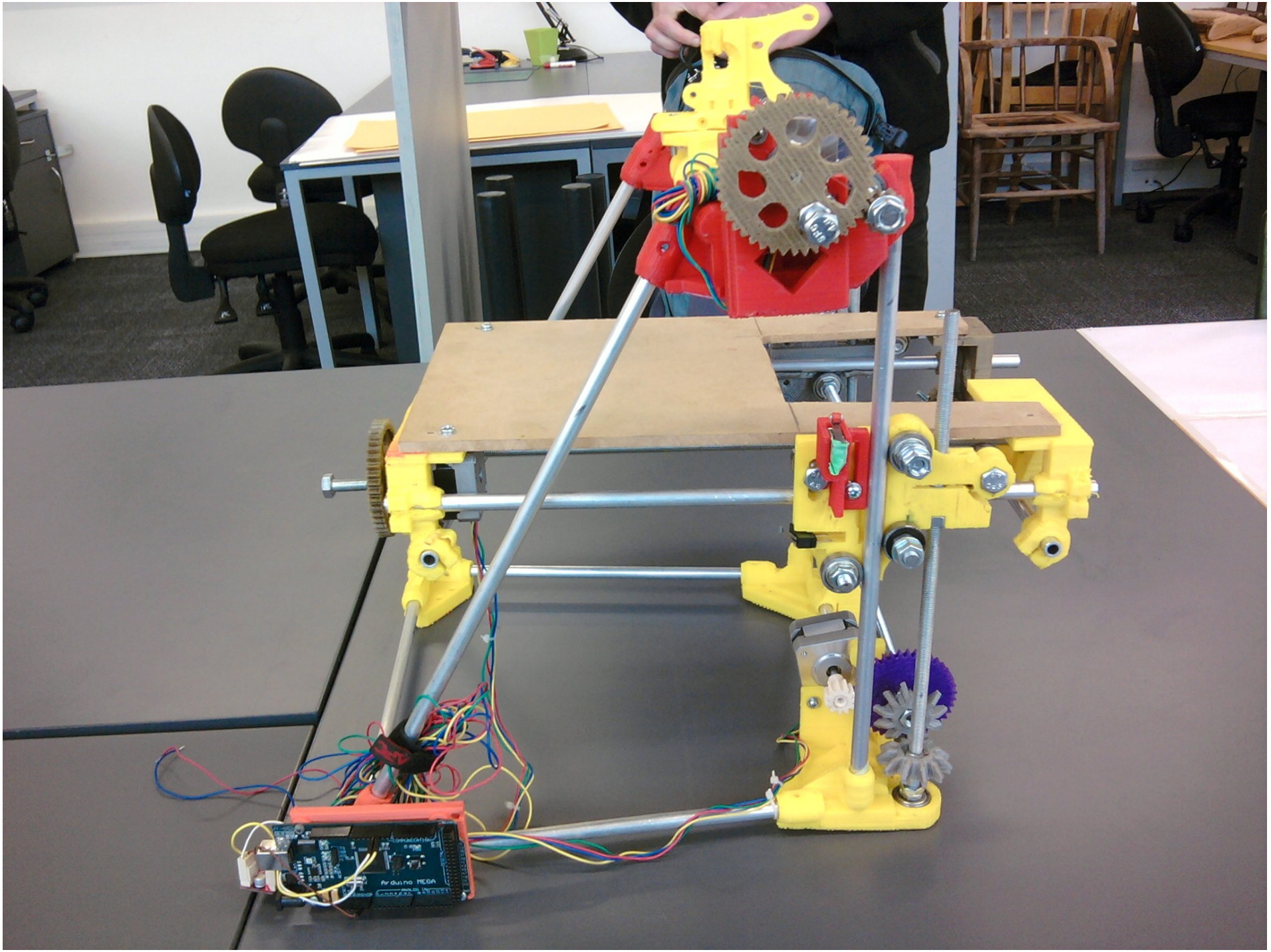
Before the Conference

- Ferry got in late
- Too late for the cheap shuttle into town
- Got a shuttle to the backpackers... but the driver took me to the wrong backpackers.
- I got to the correct backpackers... but there was no-one at reception and nobody answered the bell.
- So, I slept in the lobby until 4am when the manager saw me and let me in.
- When I got up I broke a slat on the bed.
- Then when I went to the toilet, I found it was blocked, but only after I flushed!

What Have I got myself into?

Saturday morning

- Hey, free coffee at the Un-Conference! And there's free food as well!
- Things are looking up!
- Vik Olliver was giving a talk/demo to do with the Reprap project, so, of course I went.
- He went through the “fiddly bits” and how he makes them, most of which he has documented on his website http://vik-olliver.blogspot.co.nz/
- He also had “Patches”, a new Reprap variant, “Simpleton”, that he is working on.


ARDUINO MEGA

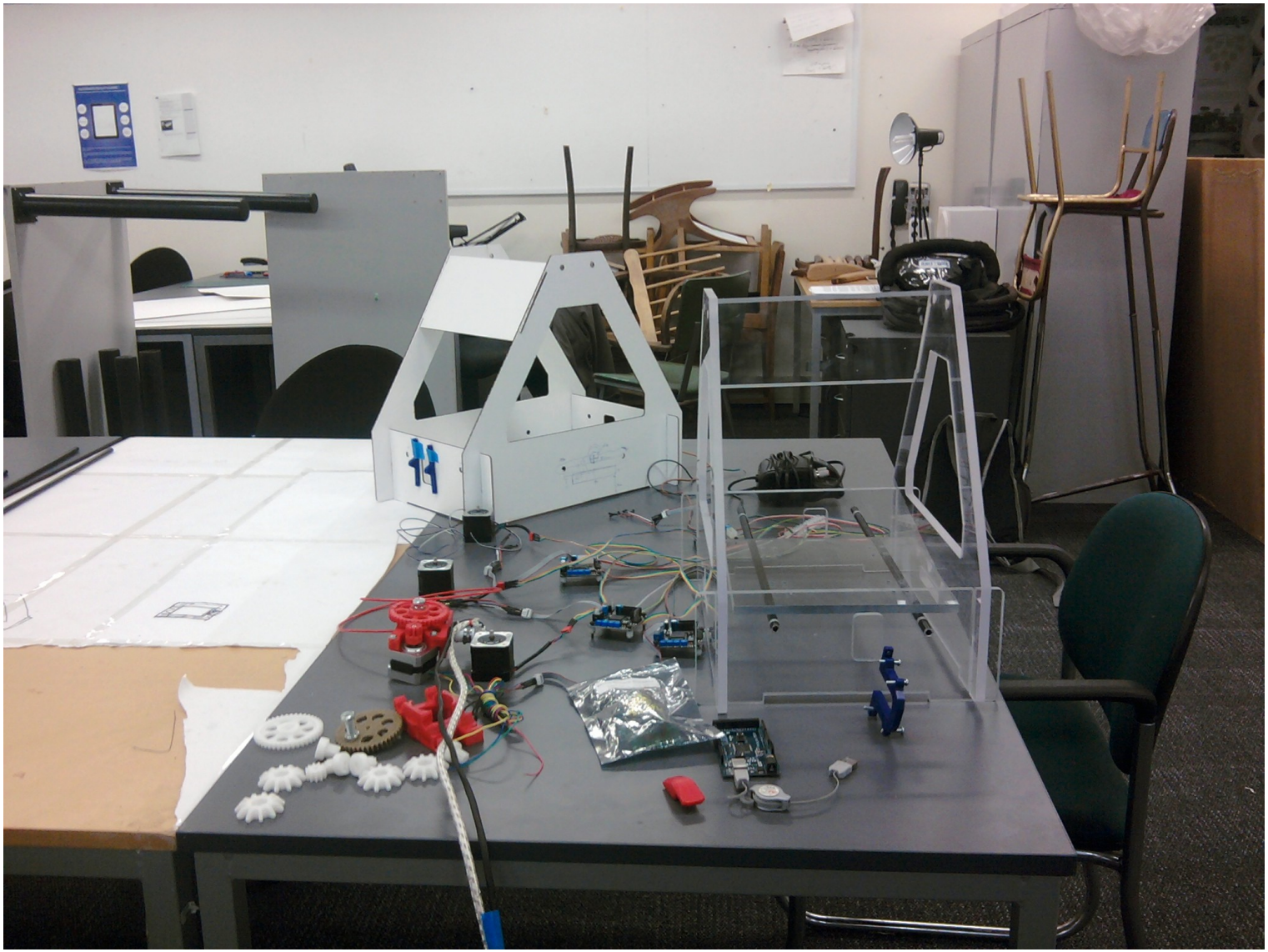
Simpleton

- No belts, all gears and rods
- Less parts in total
- Fewer printed parts, but they are individually larger than with previous variants.
- Made to be easy to build, not easy to print and sell as a kit-set!
- Main rods slot into place in plastic corner parts and then just hit it with a mallet!

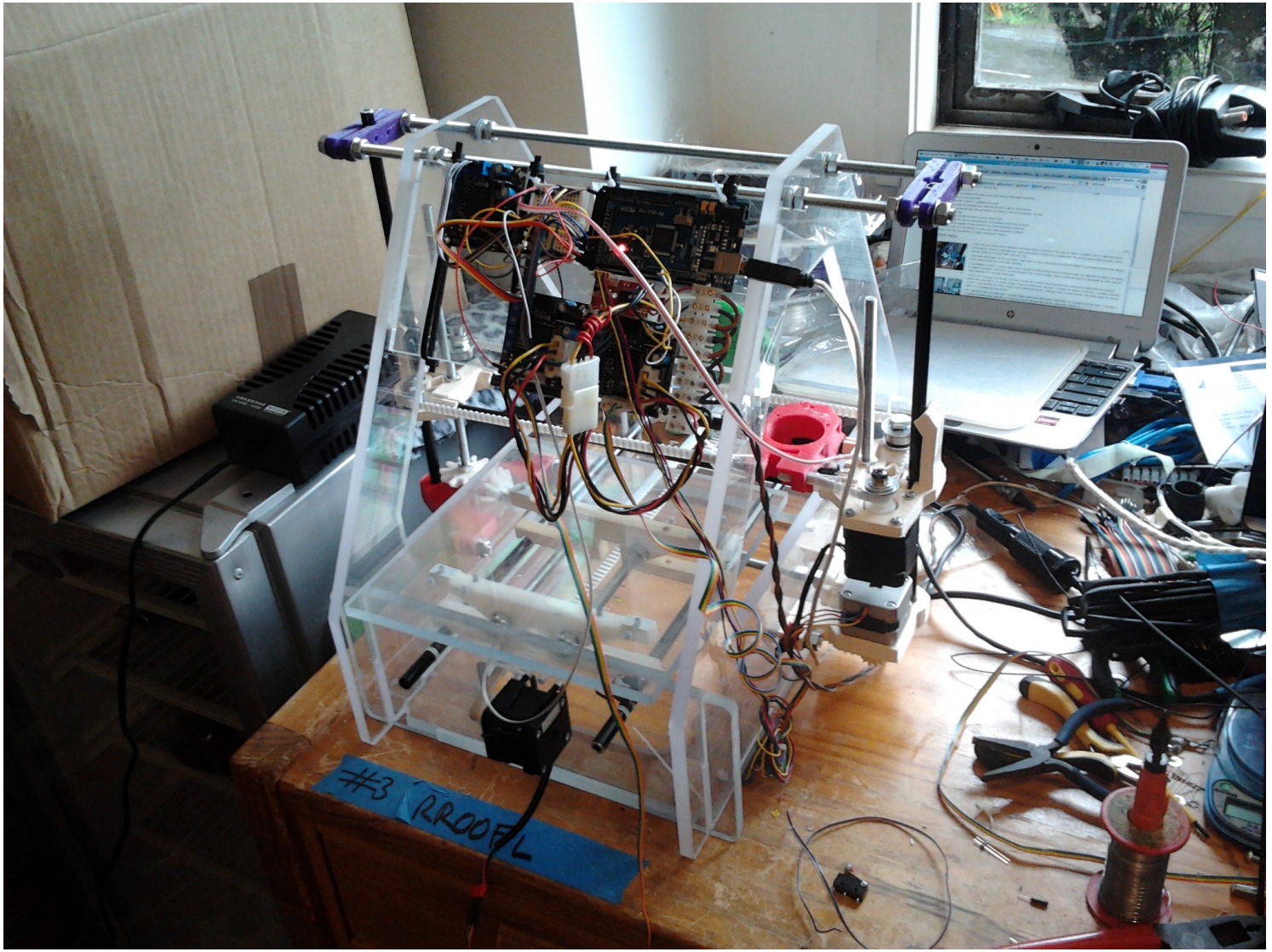
Saturday afternoon

- Mission: Design and build a new Reprap that can be made in a FabLab
- I volunteered to put together the “fiddly bits” of the extruder as it was what I needed the most practice at.
- Found that a mini-blowtorch is very handy for 'adjusting' PLA printed pieces that are not quite right.
- Vik gifted me his spare one in return for going out and buying a small screwdriver set.
- Also had some interesting conversations at lunch and afternoon tea with various FabLab people from around the world.

The final product



Rroofl - RepRap Out Of FabLab



Cool Fab Lab Tools – Waterjet cutter

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Cool Fab Lab Tools – Subtractive

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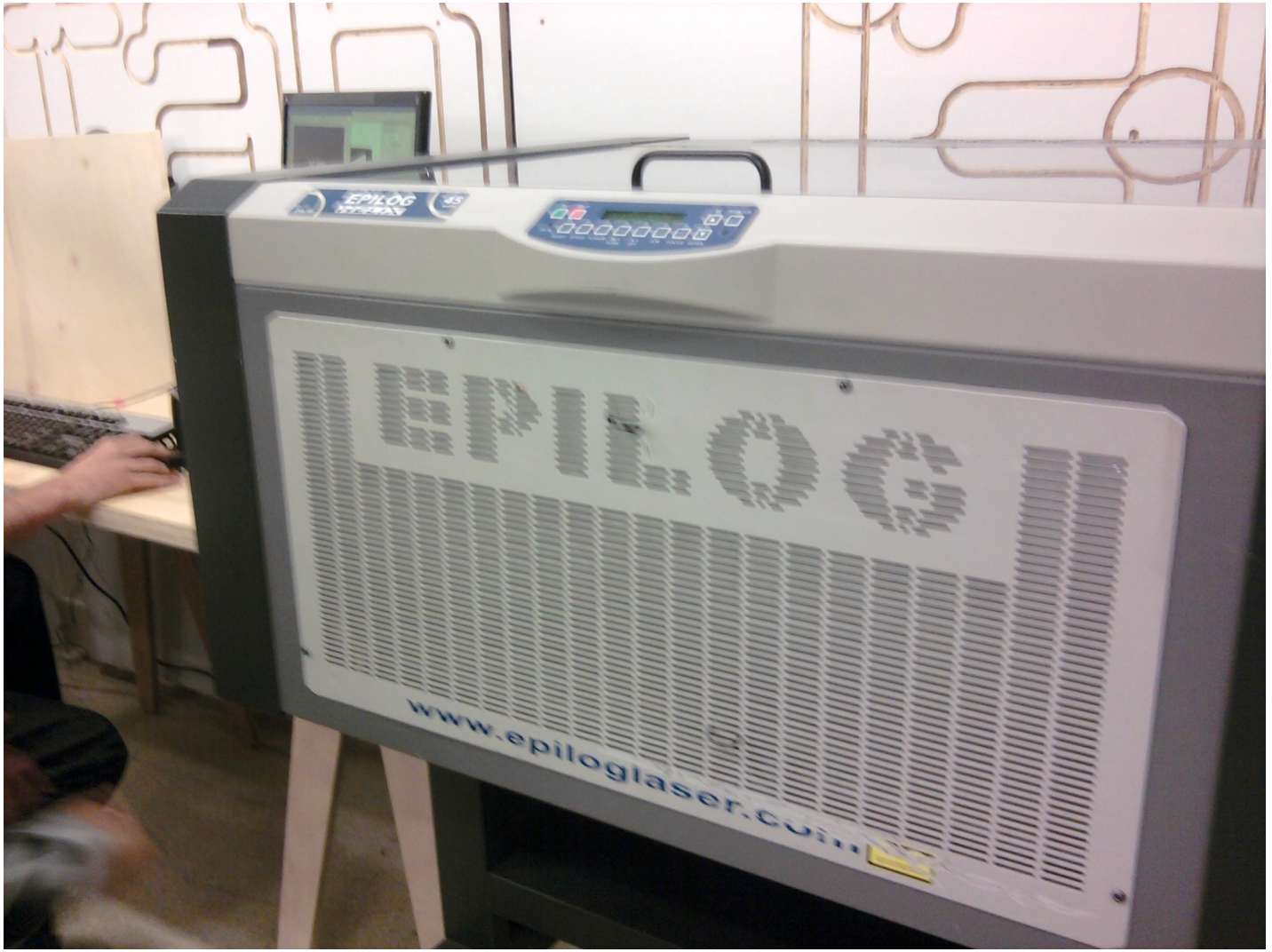
Cool Fab Lab Tools – Subtractive



Cool Fab Lab Tools – Subtractive

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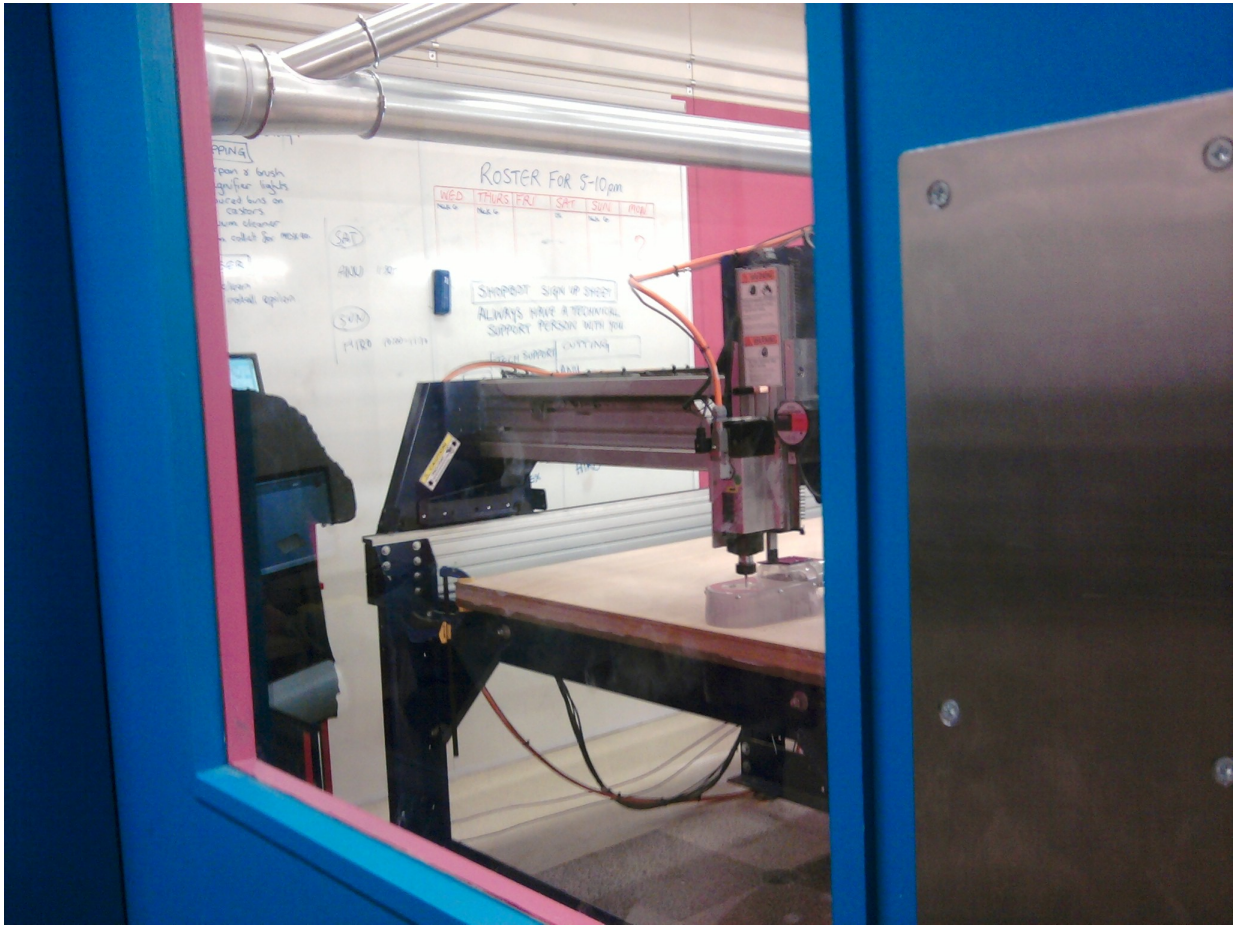
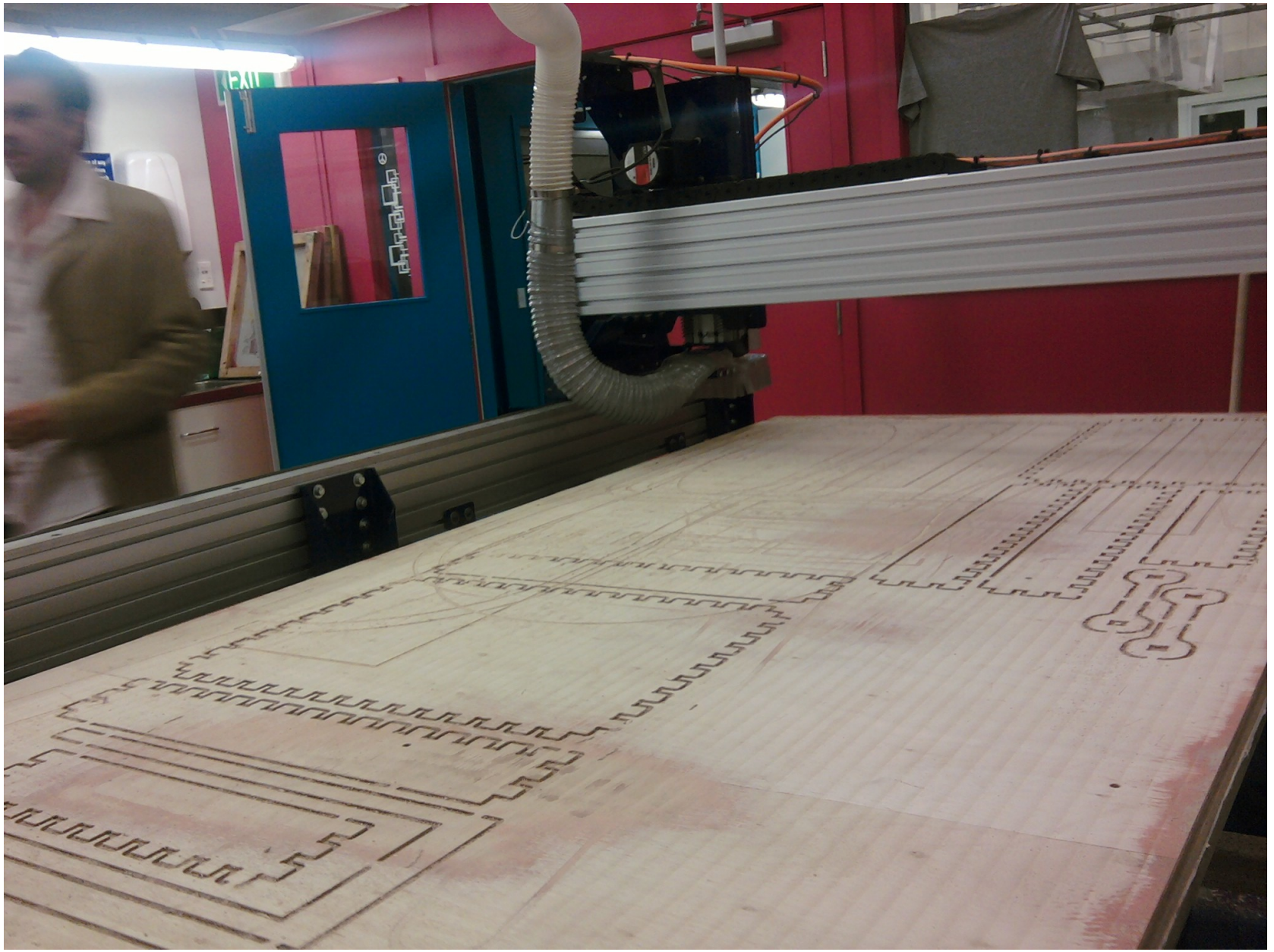


Cool Fab Lab Tools – Subtractive



Cool Fab Lab Tools – Subtractive

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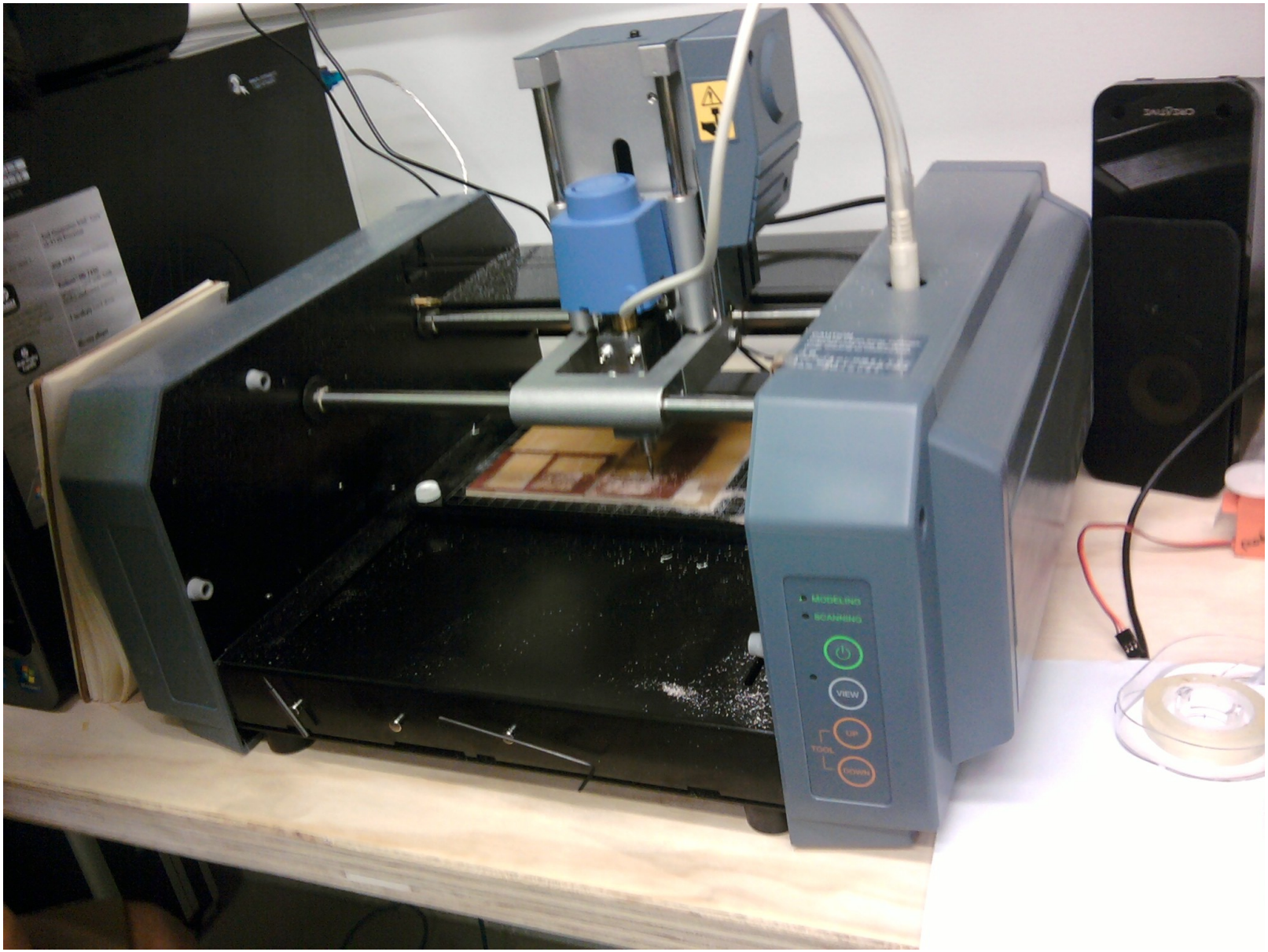
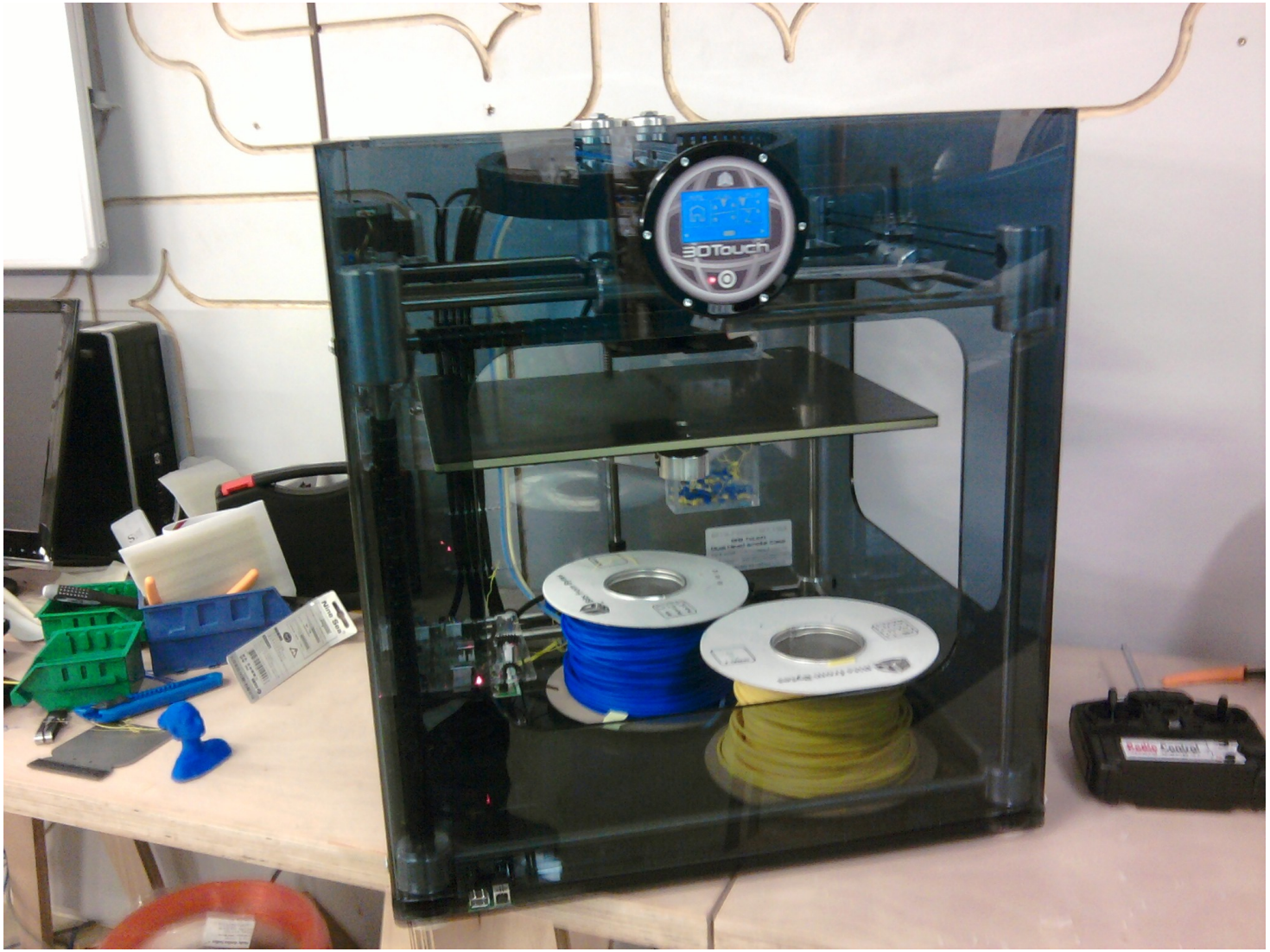


Cool Fab Lab Tools – Additive



Cool Fab Lab Tools – Additive

FabLab impressions

- Lots of cool tools. Most of them are subtractive machines, rather than additive machines.
- While I was there the additive machines were primarily used by the Reprap group to print out parts.
- There was no conflict with the other groups for the UP 3D printers as there were with the use of the Waterjet.
- Most people using the Lab could have got away with a bandsaw and a drill!
- All they saved themselves was a bit of time.
- Additive manufacturing can, in theory, do a superset of what subtractive can do, but the fact that the additive machines aren't used means that this has not seeped into the design community and/or that it is too slow to print things out with good enough resolution.

Breaking News

- KamerMaker Grand opening 16th September 2012
- Is this the solution? 2x2x3.4m print volume
- http://www.youtube.com/watch?v=o7qut2GepEU

Sunday morning

- Visited the Reprap construction and FabLab for a time and spent some time either talking to various people but...
- Analisa Russo was showing off the University of Illinois electronically conductive ink.
- The mixture is large nano-particles of Silver, 5% by weight.
- Currently, just an academic experiment but they are looking at selling pens.
- Formula is already published (I have some detailed papers if anyone wants to try)
- A minor tweak gives something that can be used in a 3D printer extruder.

Show video

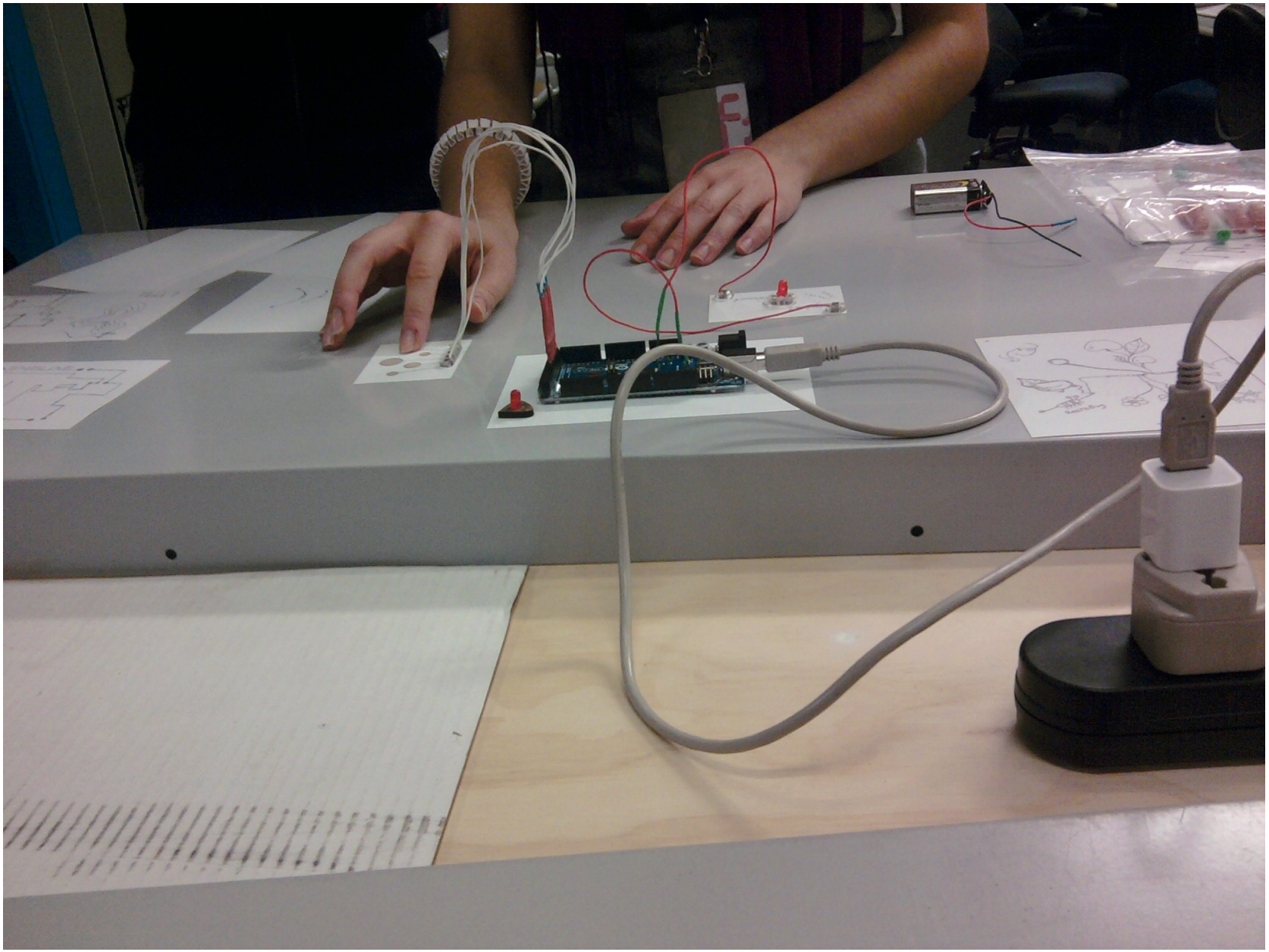
- https://www.youtube.com/watch?v=dfNByi-rrO4

DIY circuit play-time

- For public DIY they have a number of components mounted on acrylic/wood with glued on (conductive) magnets with ink-jet photo paper and a metal surface to put them on (+ pre-programmed Arduino).
- Magnetic base components means they are easy to attach (if have metal surface under the paper.
- Photo paper means that ink is not absorbed into paper and doesn't smudge.
- Not quite like writing as you need to hold pen more upright so that get consistent flow.
- They haven't looked into it much for use in combining with printing 3D structures but have already done a bit of work in drawing/extruding 2D structure under computer control with 3D printer.

DIY circuit play-time

DIY circuit play-time



Bigger Picture

- This is just a small part of what they are looking into.
- There was also a presentation at the Academic Symposium “Printing Functional Materials”
- Their focus is on exactly placing large numbers of small particles (ink particles are 250nm-250 micron) so that 3d printing can go from prototyping and hobbyist to commercial products.
- Can we improve precision by 100x and throughput by 100x?
- High throughput through multi-nozzle arrays with hierarchical branching e.g. micro-nozzle vascular printing to 64 nozzles (6 layers of binary branching)
- This gives a reduction in time for a particular print from 24 hours to 22 minutes.

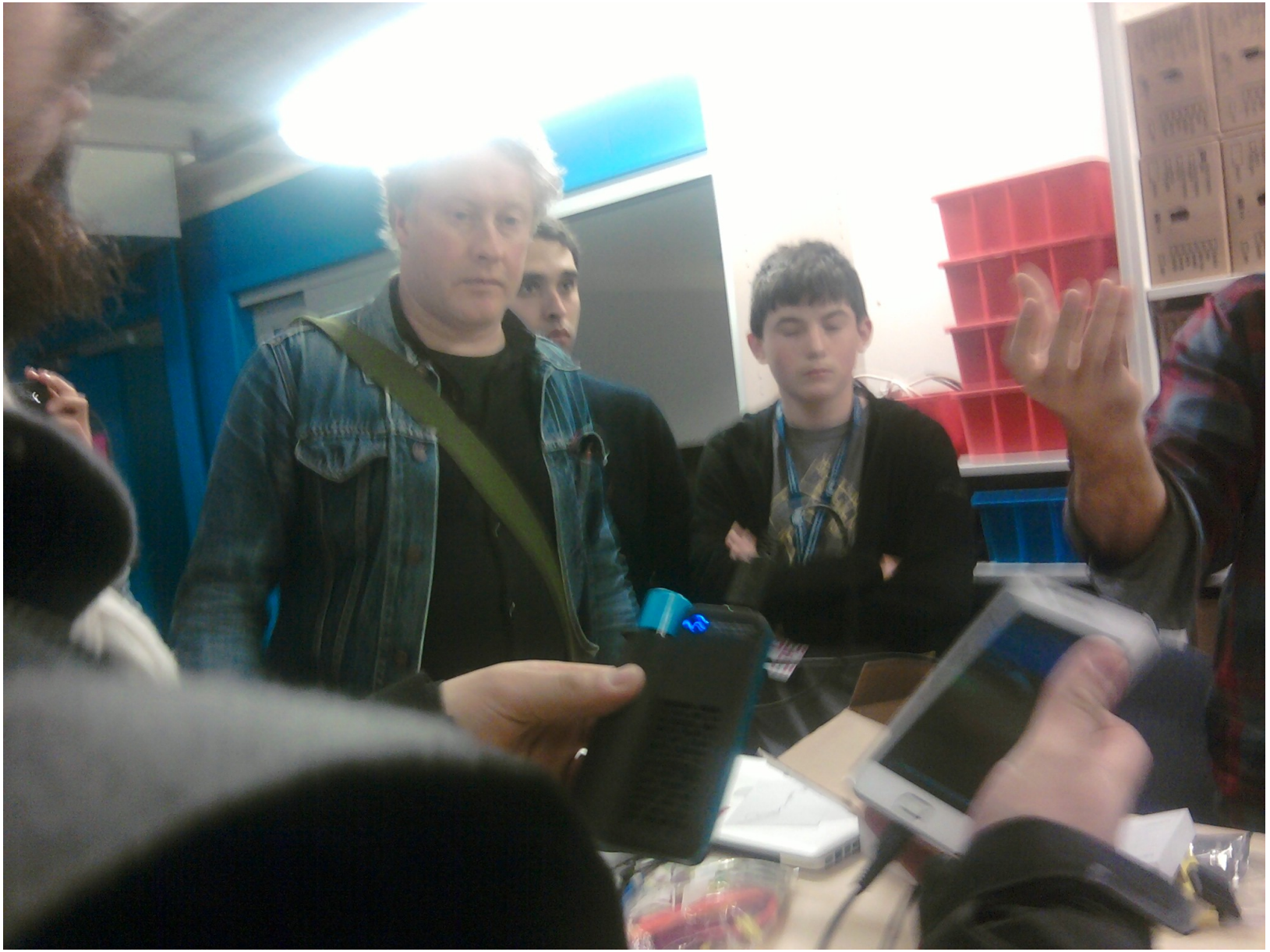
Bigger Picture

- One question was “How long to print a cell phone?”
- The answer was that it was outside of their 3-4 year time-frame but maybe the functional parts could be printed within that sort of time-frame.

Hydrogen Fuel Cell vendor

- Interesting 10-20 minute demo/spiel about a hydrogen fuel cell and add-ons.
- Available from http://www.fablabstore.com
- H2MDK = Hydrogen Maker Development Kits
- Hydrogen Storage “HydroStik” (looks like a big battery)
- Electricity +water → hydrogen conversion
- Hydrogen → Electricity + water conversion
- All-in-one Water + Hydrogen storage + steam condenser with USB power output (and maybe USB power input as well?)

Hydrogen Fuel Cell vendor



Hydrogen Fuel Cell vendor

Monday – Academic Symposium

- (Most) Video available as a 6 1/2 hour webcast at http://webcast.massey.ac.nz/mediasite/Viewer/?peid=0d1a7106050e4455b119845d4d372de51d
- But is running through Silverlight.
- The Moonlight plugin worked for me in Firefox (14?) on Ubuntu but is not currently supported in the latest Firefox.
- I thought the morning was a lot more interesting than the afternoon.
- A lot of good stuff squeezed into a short space of time.
- In the initial Intro Neil Gershenfeld mentioned there were 135 FabLabs and that number was doubling every 18 months or so.

Academic Symposium Morning talks

- Printing Functional Materials (already talked about)
- Bioprinting
- Creating a “Synthetic” Bacterial Cell
- Fabricating Fabricators
- Solar Sinter
- Rapid-Prototyping and Security

BioPrinting

- Anthony Atala had trouble with the video so the presentation was given by another member of the group.
- He gave a talk at TED on a similar subject: http://www.ted.com/talks/anthony_atala_growing_organs_engineering_tissue.html where he had a 3D cell printer print out a kidney.
- With cells you need a paradigm shift that extends beyond spatial organisation to incorporate temporal aspects of development of cell maturation and full functionality
- first Bioprinting workshop 2004 and published in 2006
- multiple cell types made from cell cultures + scaffold gel
- different constraints for different cells

Bioprinting

- - FabLab parallels but differences
  - scale 1-10 microns for a cell, DNA and cell membranes 2-3nm
  - need sterile conditions, bioscaffolds, cell procurement, growth regulation, IP considerations and equipment costs $200-300,000 apiece
- Successes
  - Urinary bladders 2006
  - Urethra ("from bladder cellular origin") 2011
  - Trachea 2011
  - Esophagus 2012
- Promising preclinical and animal studies: heart valves, blood vessels, cartilage, skin, muscle, beating heart, kidney, liver, bone
- Looking ahead: 3d organ imaging in-situ, in-situ tissue repair etc.

Synthetic Biology

- Not the same as on the schedule: “Creating a 'Synthetic' Bacterial Cell” John Glass from The J. Craig Venter Institute
- July 2010 cover of Science for first synthetic biological cell
- Synthetic cell = chemically synthesised genome.
- Cytoplasm=hardware, chromosome=OS
- He is describing what was a 7 year project
- Papers in Science 2006-2010
- Goal was to create cell library so can make cells to solve specific problems.
- Short runs of DNA are simple,reliable and predictable. Longer ones become less reliable and predictable.

Synthetic Biology

- Cells are 25-50% "biological dark matter" - no idea what the functions actually are.
- Future work? Make minimal cell and learn biological first principles from both top down (take stuff out and see if it breaks) and bottom up (put in what you think is the minimal)
- Moving life into digital work and back -> near term better understanding of life, predictability, new sources of energy etc.
- $0.15 a base now, 2013 3c a base "synthesising DNA will be essentially free. The problem is going to be knowing what to synthesise"
- Stability/mutation levels not a problem after 2 years - 1 in 100 million errors same as normal. A true minimal cell would be less stable but stability isn't the goal anyway.

Fabricating Fabricators

- history of Reprap, starting with Vik and Suz's individual involvement including first meccano prototype May 2005
- First Reprap Darwin feb 2007, replication 1st June 2008
- May 2012 Reprap wins popularity contest + no. 2 Makerbot + Bits from Bytes = approx. 50%
- PLA plastic better than ABS. Its not oil based and biodegradable in compost. It is clear and takes tinted dyes and colour very well (but not dishwasher safe). Not currently recycled as can't be known to be food-grade clean.
- Vik's bugbear: "You're doing it the wrong way" designing for minimum production cost and increases complexity vs. less complexity for end user e.g. maybe use bamboo instead of metal rod?

Fabricating Fabricators

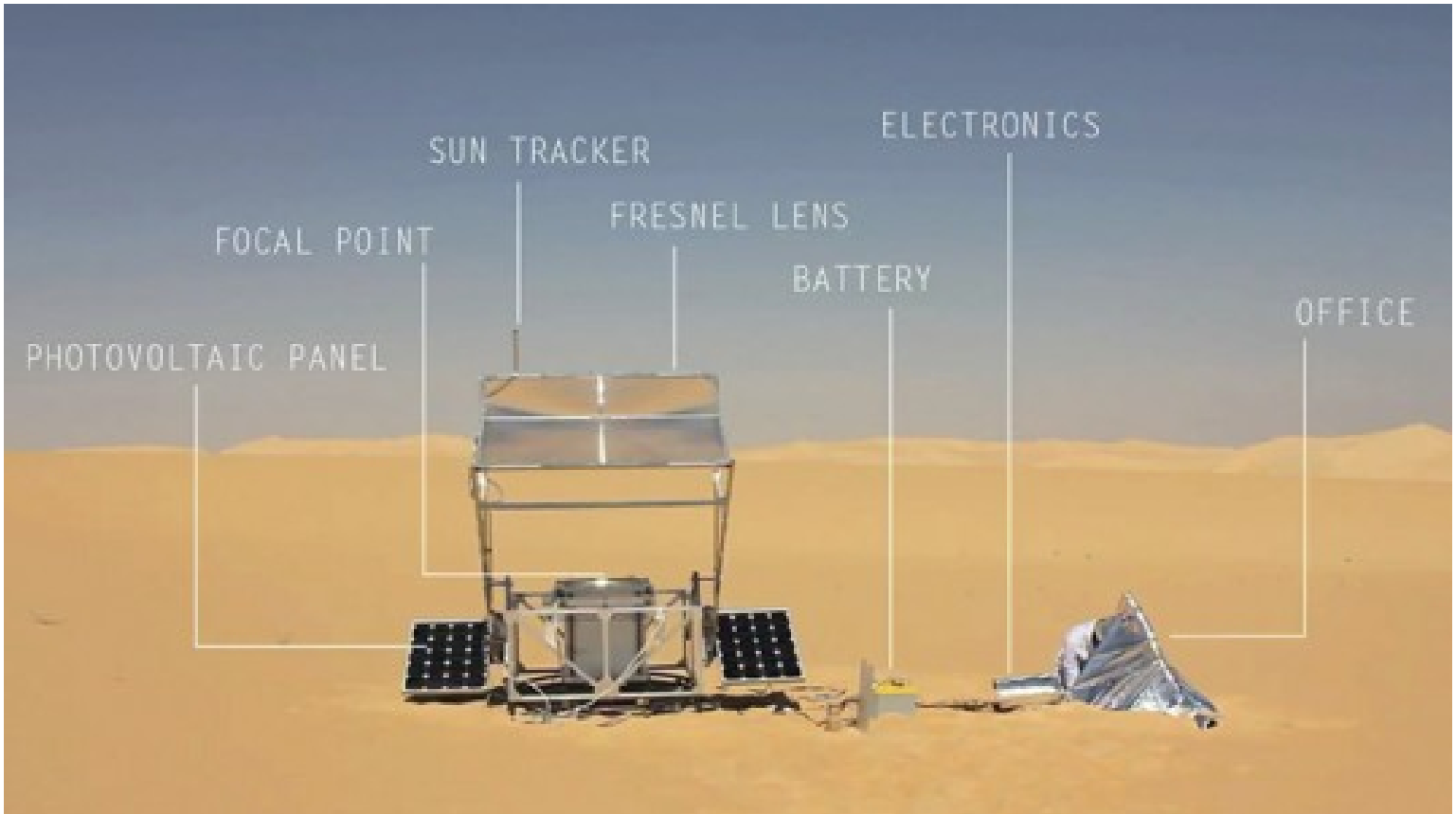
- Simpleton is the first stab at this solution
- Thingiverse has an additional 'thing' per hour
- People making and thinking e.g. a wire stipper with LED showing when wire has been stripped.
- New uses: could send ship to Mars before designs for equipment finished.
- Future directions forking: delta bots (commonly 400mm/s), multiple heads, multiple materials, metal, concurrent print heads
- As Heinlein says through Lazarus Long "specialisation is for insects"
- Lots of cool stuff on project-re.blogspot.co.nz “up-cycling”

Solar Sinter

- The talk is mostly a history of the solar sinter prototype.
- http://www.markuskayser.com/work/solarsinter/
- Focused sun melts sand into glass in desert
- Sun cutter cuts wood with ball lens focused sunlight
- Fresnel lens focus sun to melt sand into glass
- Manual manipulation experimentation for 3D printing
- Getting the mechanics right. Oh, and it needs a sun tracker!
- final prototype is solar panel + battery, focal point, sun tracker, fresnel lens, electronics (driven by reprap/makerbot electronics. He used replicatorg)
- His first good object is nice layered bowl

Solar Sinter

- In 2012 there were better quality bowls with thinner layers
- Adding additional layer of sand is currently not automated



Solar Sinter

- Show video http://www.youtube.com/watch?v=ptUj8JRAYu8

Rapid-Prototyping and Security

- Michael started with a broad history:
- New technology → bad guys using it → countermeasures
- Examples :
  - colour photocopiers → counterfeit money → change photocopiers and money
  - Laser printers → ransom letters → tiny dots on each page to identify model and serial number of printer (publicly acknowledged in 2005)

Rapid-Prototyping and Security

- Some possible bad uses of 3D printing (most of them I thought were a bit stupid)
  - Counterfeiting historic/expensive art
  - Weapons parts
  - U-235 centrifuge precursor for nukes
  - Nuke explosive lens (needs 1 in 100,000 tolerances)
  - Key and master key from locks without original key
  - Bypassing tamper indicators

Rapid-Prototyping and Security

- Why do we care?
  - Mass death!
  - Uncontrolled weapons!
  - Fraud!
  - Corruption!
  - Individual injury and death from fake parts etc.!
  - Loss of IP rights!
- Lots of !!!!

Rapid-Prototyping and Security

- But, the sensible part...
- Lets think about the problems before they occur as if we leave it to governments, they will leave it for a long time then just try to ban 3D printers which won't work.
- There is a narrow window of opportunity to do something before the industry culture and accepted behaviour is set.
- Maybe 18 months.
- Asking the question, “What can be done?”
- No answers, just asking the question.

Rapid-Prototyping and Security

- The historical examples and his thoughts seem to revolve around control through tracking but he is open to other types of answers.
- There was another guy (Mako) who gave an open communities response:
  - “The crimes you are worried about are already crimes”
  - Technology is normally better at one thing than another so if it is designed for good, it would be harder to use for bad.

Rapid-Prototyping and Security

- The consensus from both was more to the “do nothing” end of the spectrum: encourage developers to think before they release.
- A comment from Vik Olliver of Reprap about the discussion the core team had about these issues in the early days summed up most of the audience as well.
- They thought misuse was more likely to come from governments than “lone gunmen”
  - Michael disagreed.
  - Mako broadly agreed but said you can't say that all governments are bad :-)

Rapid-Prototyping and Security

- If I were to be charitable to Michael: he realises he doesn't have any answers and so he is asking questions to try and raise awareness and find answers before its too late - at which point governments will do stupid ineffective things that just annoy everyone and slow down development.
- If I were to be mean: he is just another American fear monger, afraid of anything he doesn't control.
- After talking to him afterwards for 20 minutes, I'll be charitable.

Academic Symposium Afternoon

- Instructables
- Ponoko
- Prototyping for Design and Construction (buildings and cities)
- Fabrications for and in Space
- Blurring the Lines (talk not recorded)
  - JP Lewis of Weta talking about the challenges of Avatar: avg. 1TB per day data (Avatar peak 20TB in 24 hours) + lots of other numbers. Raw division of complexity over render time per frame = 20 years to render Avatar! So need 100x speedup -> spatial hierarchy, level of detail hierarchy etc. Lots of improvements detailed in papers.
- Innovation: Good, Bad, and Ugly
- Technology and Refugees
- Te Aro Teumata: Where 2 worlds meet

What I was listening to on my mp3 player during this trip

HOPE9 DVD1 audio of the talks

Data DVD available on the Makerspace bookshelf or mp3s on media server

HOPE9 DVD1 talks you should hear

- 3D Printing: Making Friends in DC Before People Start Freaking Out - Michael Weinberg
- Community Fabrication: Four Years Later - Far McKon
- Computer Forensics: Possibility, Probability, Opinion, and Fact - Joe Cicero
- Designing Free Hardware: Scratching Your Own Itch with a Soldering Iron - Matthew O’Gorman, Tim Heath (less valuable if you have been to Paul and Brian's Dspace talks)
- The Autism Spectrum and You – panel
- Geeks and Depression - panel
- And of course, the Keynote addresses

HOPE9 DVD1 other cool talks

- I’m Not a Real Friend, But I Play One on the Internet - Tim Hwang
- The Internet is for Porn! How High Heels and Fishnet Have Driven Internet Innovation and Information Security - Chris Kubecka, Jarett Kulm
- Hack the Law - Brendan O’Connor
- Historic Hacks in Portable Computing - Bill Degnan, Evan Koblentz
- How to Retrofit the First Law of Robotics - Eben Moglen
- Jason Scott’s Strange and Wonderful Digital History Argosy

Questions?