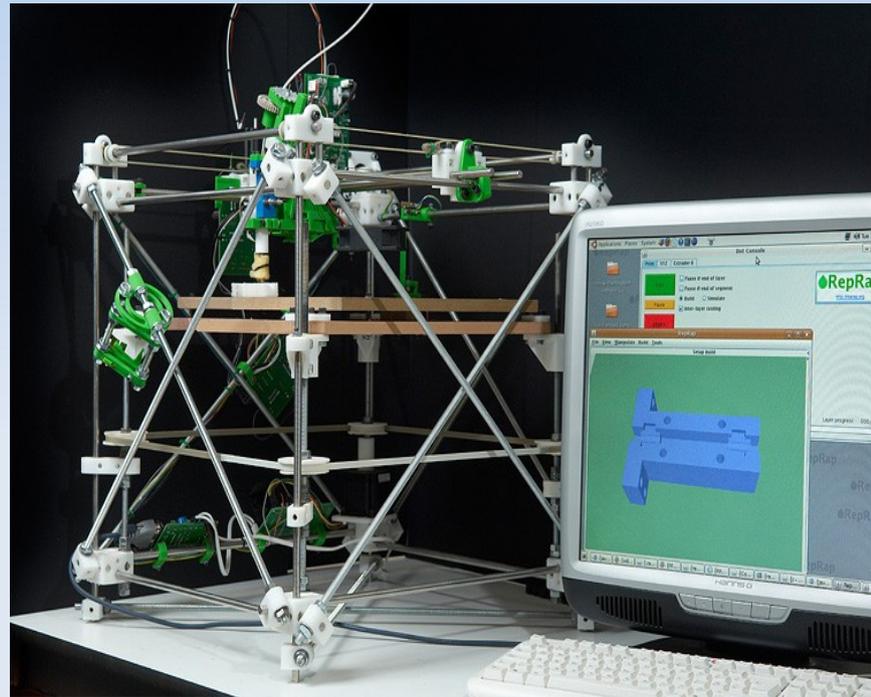


The RepRap Project

Open Source meets 3D printing

Low cost personal fabrication for the masses



Reece Arnott

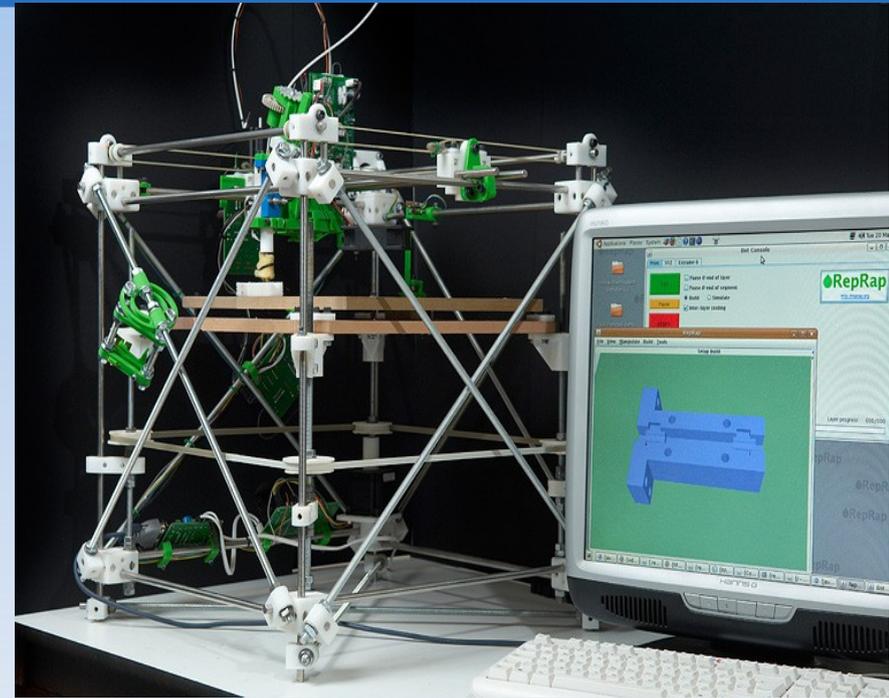
The RepRap Project

Open Source meets 3D printing

- What is the Reprap Project?
- Why?
- Past
 - Where did it come from?
- Present
 - How far along is it?
- Future
 - What are the plans for the future?

What is the Reprap Project?

“RepRap is short for Replicating Rapid-prototyper. It is the practical self-copying 3D printer shown on the right - a self-replicating machine. This 3D printer builds the component up in layers of plastic. This technology already exists, but the cheapest commercial machine would cost you about €30,000. And it isn't even designed so that it can make itself. So what the Reprap team are doing is to develop and to give away the designs for a much cheaper machine with the novel capability of being able to self-copy (material costs are about €400).”



Why a 3D printer?

- Because its cool enabling technology
- Art, electronic prototypes, final production pieces, prototypes for moulded metal parts
- Recycling at the local level
- Replacement parts for old furniture
- Toy design prototypes
- Custom modular skirting -- with motion sensors and LED lighting with built in power & comms.
- Prototype modification to Jet Skis.

Why a 3D printer?

- Small mounting pieces for miscellaneous tech.
- Custom irrigation implements, abrasion resistant cultivation tools, assorted brackets
- “A julia fractal from the magnetic class of equations with a 4 head (or 4 material head) setup. Conductive, semi, insulator and paramagnetic... in a self-similar scale free arrangement.”
- Robot parts for experimentation into bipedal walking.
- Human Organ printing.
- “Just randomly picking from my desktop: broken keyboard keys, stapler, hole puncher, watch strap, mop head, book holder , CD spindle, coat hangers, PC case, Laptop case, cell phone panel, mini camera tripod....”.

Why a *replicating* 3D Printer?

- Low cost
- Scalability
- Opportunities for experimentation/mutation
- Infinite spare parts
- Exponential dissemination.
 - It doesn't really matter how long it takes to build one
 - To get one to everyone on the planet you only need 33 doubling periods (generations).
 - If everyone gives one to 6 friends it will only take 13 generations.

Open Source Philosophy

- Communism = people are good
- Capitalism = people are bad
- Open Source = people are sometimes good (if its not too hard).
- Sharing Software
 - Human → Source Code → Compiler → Binary/Compiled Code → Computer
 - Share the source code as well as the compiled code.

Open Source Hardware

- Recipe/Instructions/Blueprints
- Pointers to exact parts and where they were bought
- Kits made up so you don't have to do the running around
- Blueprints provided in open formats that can be read in open source software products
 - Electronic circuits
 - Firmware for the microchips
 - Designs for 3d printed parts

History

- Von Neumann's Universal Constructor - 1940s
- Adrian's bright idea put to paper – 2nd Feb 2004
- Press coverage - March 2005
- I started following the Reprap blog – Early 2006
- I decided to build my own – May 2007
- My first post to the Forums - 8th June 2007
- 90% finished – January 2008

What objects have been printed?

- Small shot glass
- Toothed Gear
- Small wine glass
- Mighty RepRap Power Ring
- Coat hook
- Car dash phone/iPod bracket
- Door handle
- Child's shoes

Changes since I've been involved

- Online Parts Lister created
- The RRRRF online store opened (US based)
- Moulds for the printed parts
- Electronics changed from purpose built to Arduinio general purpose controller and sensor feedback project
- Bits From Bytes (UK based) online store opened (started with moulds now use Lasercut)
- Kits available.

Present

- To build a full 'Darwin' 1.0 Reprap you can get it using two kits:
 - Electronics kit from the US RRRF Store
 - Everything else from the UK Bits From Bytes Kit.
- I have a spreadsheet of everything I've bought and the local suppliers
- I've spent \$1,864.80(NZ Dollars)
- For the next one I think I can save a little over \$1000 to bring the cost down to a little over \$800

Present

- Live DVD available with all the software you need (plus supporting software)
 - Host software to print to a Reprap
 - Eclipse for modifying the Java Host software
 - Subclipse plugin to link into the sourceforge software repository
 - A choice of 3D design tools to make 3D objects
 - Firmware programming tools
 - Electronic circuit design tools
 - 3D Milling Software toolkit for use on CNC routers

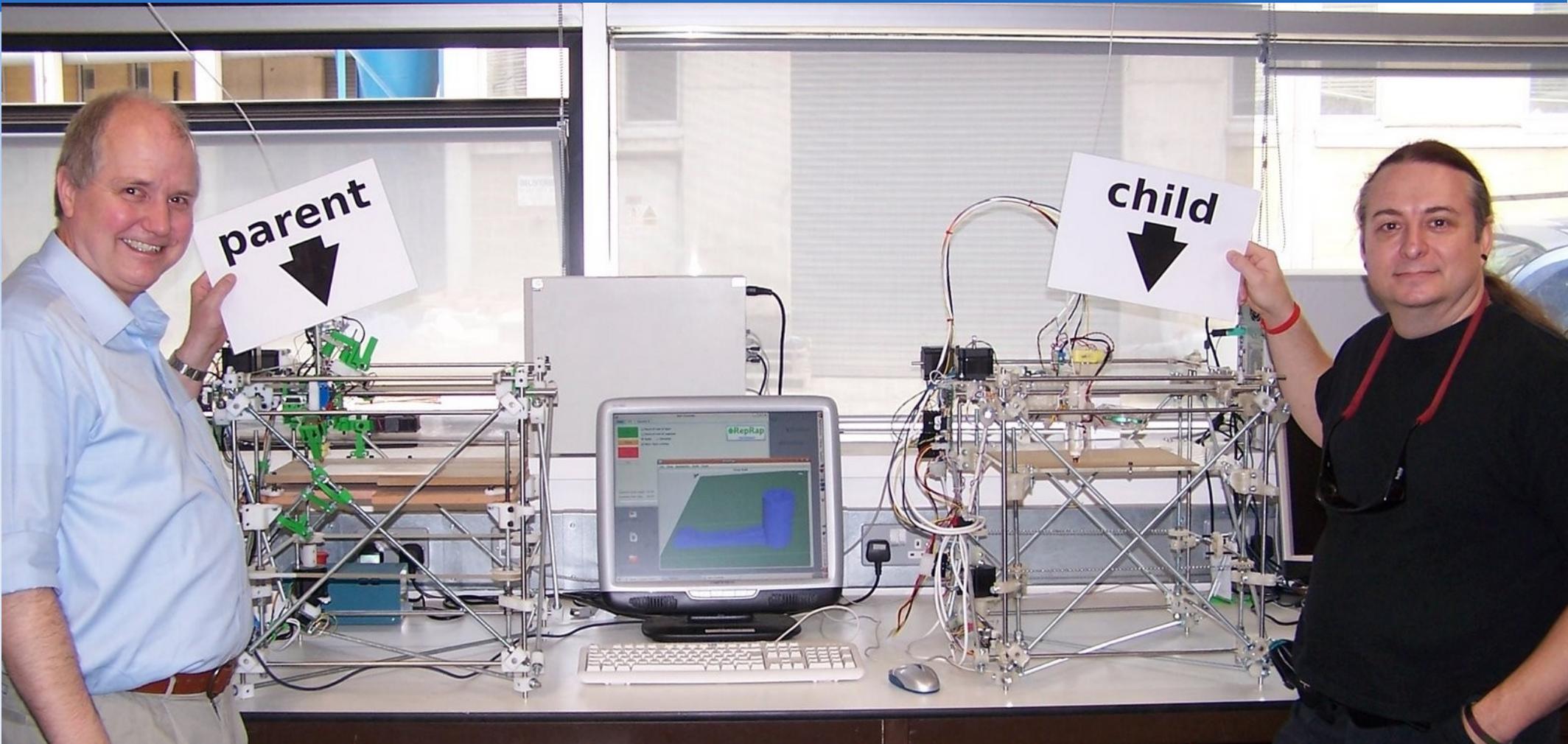
Present state of replication

- Not counting nuts and bolts RepRap can make 60% of its parts; the other parts are designed to be cheaply available everywhere.
- “But its not 100%!”
- Dearer parts first
 - Plastic parts printed on a commercial machine estimated at US\$2-3,000.
 - Cost of the plastic estimated at \$20-30.
 - Next most expensive are the electronics and the motors at around \$2-300.

Present state of replication

- RepRap achieved self-replication at 14:00 hours UTC on 29 May 2008 at Bath University in the UK.
 - A machine built with commercially printed parts printed out a full set of plastic parts.
 - Those parts were built into another machine.
 - That machine printed its first part.

Present state of replication



How many people are involved?

- Main Blog – 12 contributors
- Builders Blog – 47 contributors
- Places on Google Maps – approx. 90
- User Forums – 400+ registered users
- User Forums – 44 Geographical groups

How many people are involved?



Future – The vision of the project

- Version 1.1 – Support Material
- Version 2.0
 - Multiple print heads
 - Printing of electronic circuits. Print head capable of printing conductive material to create embedded circuits
 - Expand the online community with a custom website of objects to build.
 - Reduce number of external parts needed.
 - Internationalize the software and localize into at least one non-English language.

My Vision - Immediate Future

- Print out a set of parts
- Build another Reprap
- Give it away to an interested party (can my parents use one?)
- Help others build them.
- Time to build:
 - My second one: 80 hours or 2 weeks solid work
 - Two people: one master, one apprentice: 2 weekends solid work.

My Vision - Medium Term Future

- PhD research
 - Start to make it usable for normal people
 - A way to personalise pre-existing software objects
 - 3D scanning
 - Make sure my parents can use it
- Decrease the time to install and get to know software and print out meaningful objects
 - Currently at least 1 hour
 - Goal to get that down to 10 minutes for most educated people

My Vision - Long term Future

- Simple and effective ability to personalise objects
 - Push button scanning/printing machine type arrangement
 - Useful to those with little or no formal education
- Useful for friends in weird and wonderful parts of the world.
 - Primary medical doctor in small rural hospital in Papua New Guinea.
 - Hydrologist working on irrigation in Ethiopia.

My Vision - Long term Future

- Extremely long term (20 years)
 - Desktop nanofactory
 - search for “nanofactory” on YouTube.
 - Help with the Space Elevator



Want to help?

- I need a PhD supervisor!
- Come and talk to me.
- Email me: rarnott@business.otago.ac.nz
- Read through the stuff on the reprap.org website
- Post to the forums with any questions
- Find a problem within your field of experience and come up with a solution.