The RepRap Project
Open Source meets 3D printing

Low cost personal fabrication for the masses

Reece Arnott
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- 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).”

- From http://reprap.org
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 it's 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 – 2\textsuperscript{nd} 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 - 8\textsuperscript{th} 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 RRRF online store opened (US based)
- Moulds for the printed parts
- Electronics changed from purpose built to Arduino general purpose controller and sensor feedback project
- Bits From Bytes (UK based) online store opened (started with moulds now use Lasercut)
- Kits available.
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
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.
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.