From 3D Printing and Personal Fabrication to Personal Design
Today

- Personal Fabrication: Concepts and tools
- Fab Labs
- Personal Design and HCI
The 3rd Digital Revolution?
Digital Revolutions

analog → digital communication
~1945

analog → digital computation
~1955

analog → digital fabrication
~2005

Source: Gershenfeld 2010
After Gershenfeld 2010

Errors

Noise

Analog

Analog+

Digital
lossless

fast

cheap
Personal Fabrication (Fabbing)

- Personal, digital fabrication of goods
- Personalizable to individual needs unlike mass-market products
- Largely missed by corporate world until now
Lasercutter
If you're looking for a CNC solution for production that delivers high performance, high volume, speed and reliable power for all cutting tasks, ShopBot's PRSalpha series of full-sized gantry tools will be your system of choice. With enough production capability for a three-shift factory, ShopBot PRSalpha tools are our toughest, most sophisticated, gantry-based CNC routers. Using advanced technology for CNC cutting, drilling, carving and machining, the PRSalpha series tools deliver rapid transit speeds of 1800 inches per minute and cutting speeds of up to 600 inches per minute. Easy to configure and re-configure, learn and use, the PRSalpha CNC delivers affordable, full-production performance in digital fabrication of wood, plastic, aluminum, and other materials.

Traditional shop-size and larger. ShopBot builds CNC gantry tools in many sizes to suit the varying needs of manufacturers: 96 x 48, 96 x 60, 120 x 60, 144 x 60. Give us a call to discuss your production needs. We'll help you to choose the right tool to get the job done.

Call to order your Full Size Shopbot CNC router. 888-680-4466 ShopBotTools.com
Obstschale
by Jakob Henke
Four Stages

• Fab 1.0: Expensive digital machines on dumb materials
• Fab 2.0: Easily replicated machines that make (MTM)
• Fab 3.0, 4.0: Smart, self-arranging (replicating?) materials
Physical Literacy

• Correcting historical error (“liberal arts” excluded making stuff)

• Reunite arts and artisans, creator and consumer
Impact on Society

http://www.bbc.co.uk/news/technology-22423883

Source: hackaday
The Law

1. You can't infringe trademarks
2. You can't forge (pass off)
3. You can't make copyright figurines
4. You can't include copyright artwork
5. You can't sell patented items
6. You can pretty much do anything else...

Fab Labs

- Free, open access
- Teach “revolutionary” skills
- Community based
- 60 around the world
- Fab Lab Aachen: Germany’s first
- http://fablab.rwth-aachen.de
we make things
no war

Fab Lab
Afghanistan
Personal Fabrication *Enables* New HCI Design/Research/Teaching Practices
Personal Fabrication *Requires* New User Interfaces
Reprap 3D printer
$40,000 → $400
Altair: $397 (1975)
Lego Compatible Disc Buttons

How do you make a great idea like Makerbot-printable (clothing) buttons better?

Why, make them Lego Compatible! Naturally.

Update 2009/10/04: In the design files, the knobs are 5mm in diameter. I remeasured my source Lego disc after getting back some Shapeways test prints and the Lego knobs are actually closer to 4.8mm in diameter. I lucked out with my MakerBot-printed buttons; shrinkage brought them down to about 4.9mm in diameter. The Shapeways printed versions are more accurate, 5.00mm diameter, +/- 0.05mm. There's enough give in the plastic materials for them to still fit 'regulation size' Lego blocks, but the metal one was simply too wide a diameter.

Update 2009/11/07: I've been playing around with OpenSCAD (http://www.openscad.org/) and came up with the attached DiscButton_20091107 variation. I even added bottom "sockets" to this variation. It's almost too easy when it's all code!

Disclaimer: LEGO is a trademark of the LEGO Group and these explorations are in no way associated with LEGO Group. Heck! The files are CC-licensed; nothing to stop them embracing and extending it themselves if they so chose! :-)

Jan Borchers, RWTH Aachen University: Personal Design
Make awesome stuff.
Flat is boring. Capture your world in 3D with free Autodesk 123D apps.

→ Meet the 123D Apps

123D
Design stuff you really want to make, send it straight to a 3D printer.

123D Catch
Automatically convert ordinary photos into extraordinary 3D models.

123D Sculpt
Shape and paint digital clay into amazing 3D sculptures on your iPad.

123D Make
Transform 3D models into a pattern for assembling real artful creations.

Jan Borchers, RWTH Aachen University: Personal Design
VisiCut

- The VisiCalc of LaserCutting
- Open-source, free
- [http://hci.rwth-aachen.de/visicut](http://hci.rwth-aachen.de/visicut)
Jan Borchers, RWTH Aachen University: Personal Design
FabScan (RWTH)
hci.rwth-aachen.de/fabscan

$150

Jan Borchers, RWTH Aachen University: Personal Design
FRONT: Sketching Furniture (2007)

Jan Borchers, RWTH Aachen University: Personal Design
Cassius Lamp
(AEC ’09)
Sketch Chair
(Greg Saul, 2010)

Jan Borchers, RWTH Aachen University: Personal Design
WHAT?

Food
Furniture
Consumer electronics
(Registered)
Toys
Weapons
Replacement parts
Prosthetics
Art
Small-market gadgets
3D Scan

AI, Assistants, Templates

Crowdsourcing

HOW?

Parameterization

Download/Query

Gesture

Touch & Haptics

CAD
## Personal Design vs. Personal Fabrication

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<th>Local Design</th>
<th>Outsourced Design</th>
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<td><strong>Local Fabrication</strong></td>
<td>AutoCAD + RepRap</td>
<td>Thingiverse</td>
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<td><strong>Outsourced Fabrication</strong></td>
<td>Shapeways</td>
<td>Traditional</td>
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HCI Research Topics

• Tools for HCI Research
  • Examples: SLAP, Madgets, Pneumatic Displays (CHI 2009)

• Software for Fabrication
  • 123D Make (Autodesk)
  • SketchChair.cc (Igarashi)

• New Interactions for Fabrication (beyond CAD)
  • FreeD
  • Constructables
FreeD: A Freehand Digital Sculpting Tool

- Amit Zoran, Joe Paradiso (MIT), CHI 2013 (vimeo.com/59826043)
- Handheld milling device knows 3D model, constrains sculptor to avoid, e.g., carving too deeply
Milling bit  Magnetic sensor  PCB
Handle (on a linear bearing)  Servos  DC motor

The fabricated object
The FreeD tool
PC
Rhino
3D model
Grasshopper
Motion tracking
Polhemus FASTRAK

FreeD
Spindle
Shaft
Control PCB
Polhemus FASTRAK sensor
Interactive Construction

- Stefanie Mueller et al. (HPI), UIST 2012 (youtu.be/8g3LaF9oVFY)

- Use laser pointers to draw on material, lasercutter cuts interactively
• “People doing strange things with electricity”

• International network of people doing interactive art and electronic hacks

• We launched the Aachen dorkbot chapter in 2009

• Meetings every 3rd Wed of the month, here (room 2222)

• dorkbot.de