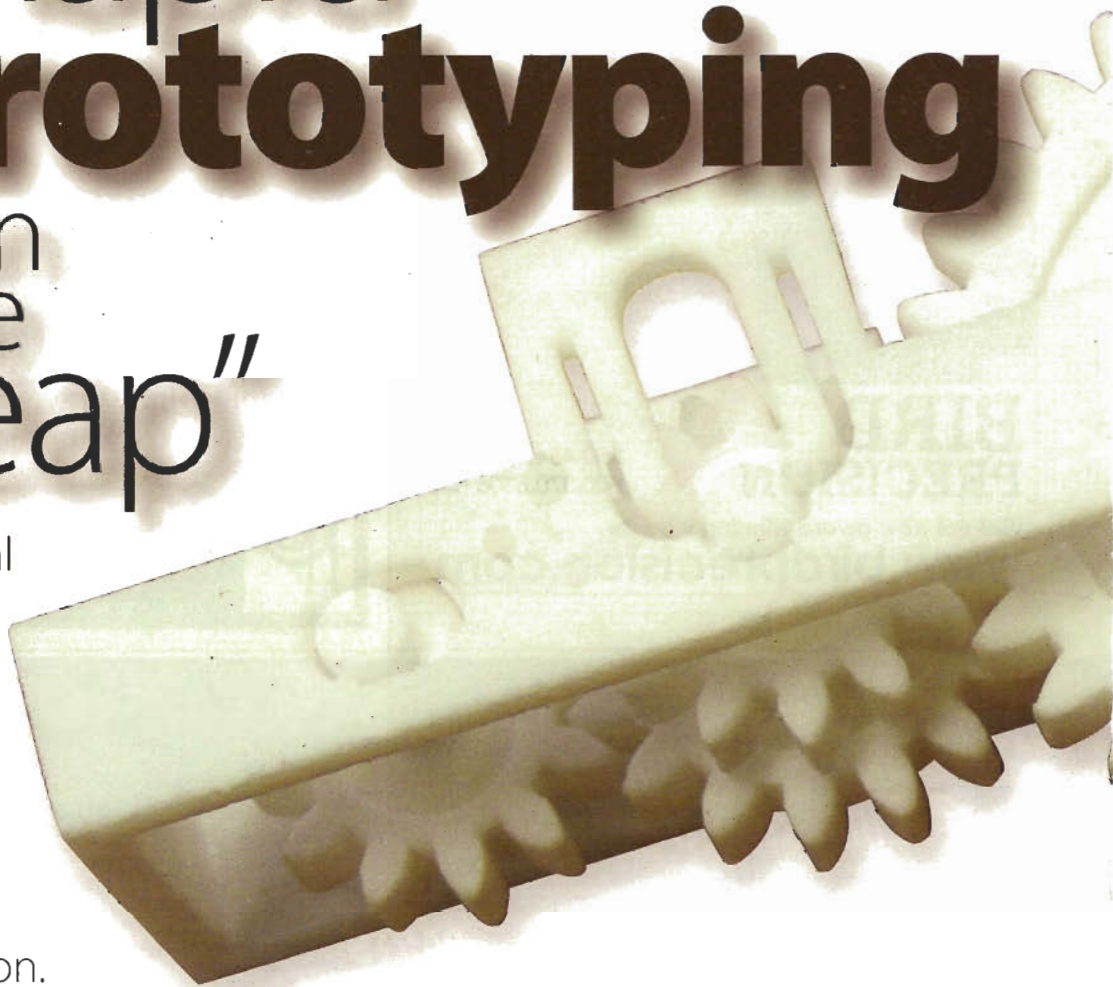


Rapid prototyping

"on
the
cheap"

Mixing social networking with digital fabrication provides a recipe for rapid mass customization.



New approaches to rapid manufacturing let almost anyone inexpensively produce parts, products, and prototypes. So says Ted Hall, founder of **ShopBotTools** in Durham, N.C. Perhaps you recall the "Fab Labs" (fabrication laboratories) that Neil Gershenfeld of the Massachusetts Institute of Technology established a few years ago in universities, colleges, housing projects, and mobile labs. Their goal was to give ordinary people manufacturing and prototyping capabilities not otherwise readily avail-

able by providing free access to tools such as 3D CAD, laser cutters, and desktop milling machines.

Fast forward a few years and all the Fab Labs, as well as thousands of other small shops, now include a digital fabrication machine — the ShopBot CNC router. The machine provides a large three, four, and five-axis format for making items such as a headboard for your kid's bed as well as industrial parts including large-scale propellers for wind turbines, prototypes for new solar-power devices, and parts for emergency housing from wood, plastic, metal, and composites.

Hall says the company partnered with another firm to create the online fabrication community www.100kGarages.com, which takes a nontraditional approach to selling products. Basically, anyone can upload their designs and find local fabbers to make them. Users can also buy other people's online designs. The other firm, **Ponoko**, Wellington, New

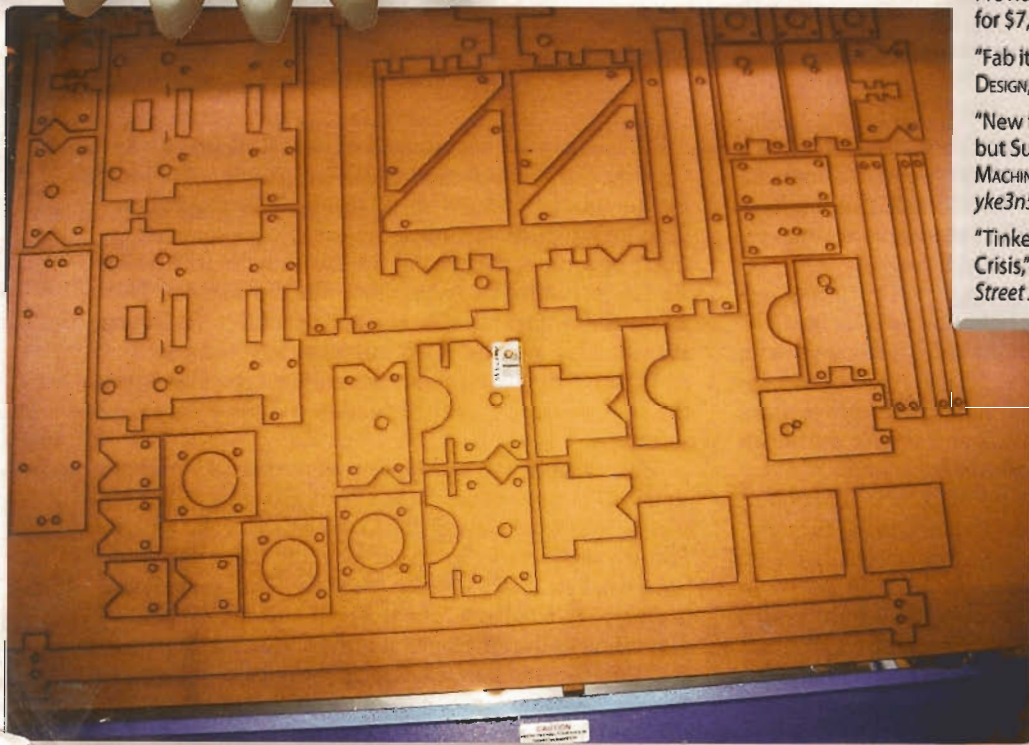


WHAT'S THIS?

When you see a code like this, take a photo of it with your smart phone (iPhone 3G-S gives best results) and, using software from www.neoreader.com, you will be connected to relevant content on machinedesign.com



The Shapeways site includes a section on mechanical design featuring prototypes such as this user-designed spur gear.



The pieces on this metal sheet were laser cut for a Cartesian robot by a 100kGarages contractor.

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Resources and links:

100kGarages, www.100Garages.com

Fab Academy — Gershenfeld has created an online school focused on the principles and applications of digital fabrication. Watch a video of a recent Web conference featuring him and several Fab Labs from around the world discussing their various projects. One of the speakers is Ted Hall, of ShopBotTools: <http://www.fabacademy.org/moodle>

MakerBot, <http://makerbot.com> — Provides an open source 3D printer that costs under \$1,000. It prints with ABS plastic.

Ponoko, www.ponoko.com

Shapeways, <http://www.shapeways.com> — Lets users upload a model or create one with tools on the site. The company then uses one of its partner shops to inexpensively 3D print the design in plastic, metal, or other materials. Parts are said to ship within 10 days.

Sherline, www.sherline.com — Provides miniature lathes and milling machines for machining small parts in any material.

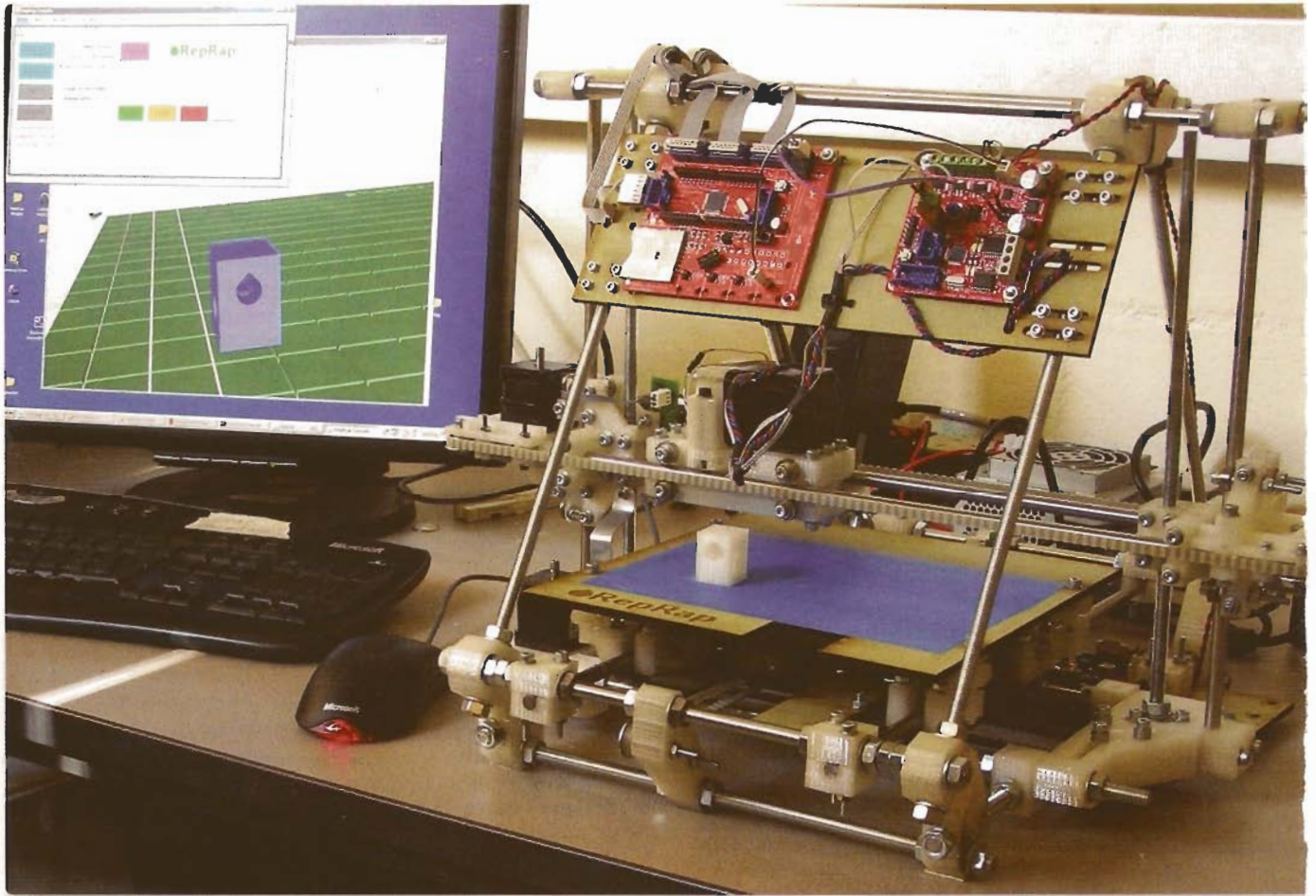
ShopBotTools, www.shopbottools.com

Tormach, www.tormach.com — Provides a "personal" precision CNC mill for \$7,480.

"Fab it Now," May 22, 2008, *MACHINE DESIGN*, <http://tinyurl.com/yke88kl>

"New from the Fab Labs: Lightweight but Superstrong Parts," August 7, 2008, *MACHINE DESIGN*, <http://tinyurl.com/yke3n5q>

"Tinkering Makes Comeback Amid Crisis," November 13, 2009, *The Wall Street Journal*, <http://tinyurl.com/y859eye>



One of the products available on the Ponoko site is the RepRap 3D printer. It closely resembles the earlier Fab@Home developed by researchers at Cornell Univ.

Zealand, also has products that reside as design files on a server, ready to be manufactured (laser cut), on demand. In providing a mechanism to connect small, global cells of fabber “garages,” these and similar firms are sometimes referred to as the “Facebook of manufacturing.”

The sites plan to eventually support 3D printing, according to Hall. “For now, though, our focus is on CNC routers because they are one of the most generally useful digital-fabrication tools,” he says. “Routers can cut items as small as jewelry and as large as houses. They prove more realistic in terms of price, material, and size for the one to six-man shops in our distributed fabber network.”

The firm’s aim is to further build libraries of content filled with downloadable, ready-to-run cutting files. According to Hall, *www.Ponoko.com* was originally set up so ordinary people could post their cutting files and then get back the laser-cut parts. Users post ESP files created in vector-based programs such as Adobe Illustrator or Corel Draw. (In contrast, ShopBots favor DWG, DXF, and a few other formats.) Over time, the site has also become a gallery for designers.

“Designers are encouraged to post stuff free under a Creative Commons license which lets people use a design but not turn around and sell it,” says Hall. “At this point, we don’t know which way things are going to go, so we are trying to encourage everything. To this end, the 100kGarage site has just added free parametric files, for instance. These let users download the file of a 2 × 4-ft object, say, change the variables, and the object automatically becomes 3 × 5 ft. We are also talking about integrating capabilities from the free version of **Alibre** parametric modeling CAD software.”

Interestingly, and reminiscent of the Fab@Homes personal 3D printers created a few years ago at Cornell Univ., Ithaca, N.Y., (and named after Gershenfeld’s Fab Labs), the Ponoko site includes as one of its many customizable designs what is called a RepRap (short for Replicating Rapid-prototyper) billed as a “practical self-copying 3D printer.” According to the developer, it provides the RepRap under the GNU General Public Licence. That means if you have a RepRap machine, you can use it to make another machine and then freely give it to a friend. **MD**