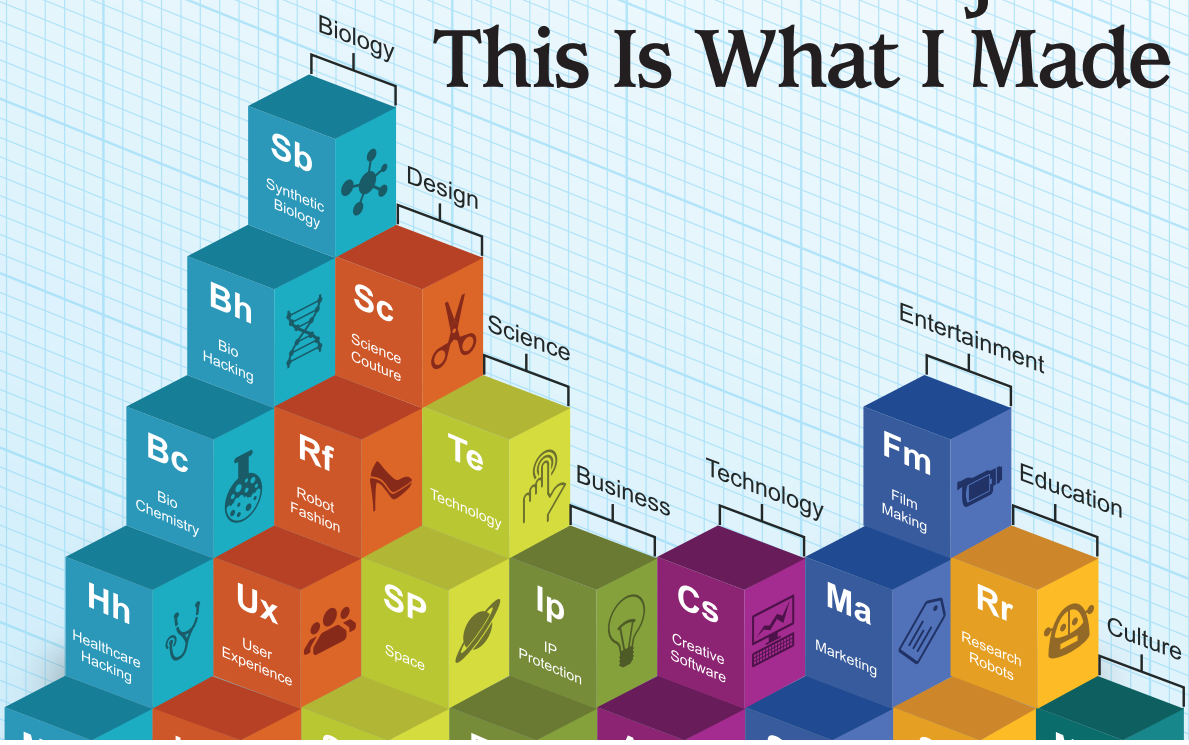
Passionate Projects: This Is What I Made



Passion for their work—whether in fashion, technology for the blind, water conservation, or Lego robotics—drives makers to render their individual visions in tangible forms that can benefit others. Here, 10 makers share what they're making.

The projects profiled in this section are as diverse as the people making them. Driven by a singular passion, each maker is changing the nature of how … well, how *everything* is made, from fashion to film, from lunchbox computers to wearable hardware for dogs. These makers see the world in a unique way, and they express their singular ideas in the technology, devices, products, and ideas they're building.

Here, you'll find a bracing tonic of youthful creativity from abundantly fresh perspectives. We purposely sought out young makers to discover their unburdened viewpoints. Some solutions they offer are pragmatic; others are heartfelt. But all show the power that young minds can exert on the making process.

We also searched for people whose goal is to change the world. From a gray-water reuse system developed for a Bangalore apartment complex to a Silicon Valley–conceived project that connects startup ecosystems worldwide—these ambitious makers' bold, exciting visions look far beyond the physical things they're making.

Passionate projects like these challenge the very nature of design: what's made, how it's made, how projects are chosen to begin with. Each production process is unlike any other, and the makers themselves span a wide swath of age, gender, and nationality, representing a small slice of what making looks like across the globe at the beginning of the 21st century.

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Slow Fashion

Crystal Beasley

Humans have three basic needs—shelter, food, and clothing. Two have seen massive changes in worldwide awareness and buying habits. "Green building" certificates now denote environmentally sound homes. Even more widespread is a "slow food" revolution, which has spawned thousands of restaurants, revived local farmers' markets, and put organic produce in supermarkets everywhere. The laggard is clothing.

I believe what you put *on* your body should be as great as what you put *in* it: local, healthy for the environment, produced with living-wage labor—slow fashion, if you will.

But there's a hard lesson to be learned from the slow food movement. If an organic tomato were merely more organic and environmentally beneficial, how much would we care? Would we pay twice the price if it weren't also way more delicious? If a product isn't in some way better than the mass-produced equivalent, getting the premium price its manufacture requires will be a hard sell. For slow fashion, one way to "more delicious" is through better-fitting clothes.

Right now, the global garment trade isn't designed to make clothes that fit or last a long time—it's optimized for volume and cost. It cranks out as many garments as possible, dirt cheap, and it works really well. We buy more clothes than ever before, and at the lowest price in history.

The problem is that it's left us with a sizing system that has nothing to do with reality. It's also left us with a buying model that has profit going to retailers instead of the people who make the clothes. That $10 pair of jeans or $3 shirt we thrill to find on a sale rack is only possible if a Cambodian or Bangladeshi sweatshop worker is paid $3 a day—not even a subsistence wage.

We need more than just a new clothing line; we need a new way of making and selling clothes. I'm looking to replace multimillion-dollar, mega-volume, low-wage factories with smaller, more customizable ones that can deliver better-fitting, higher-quality clothing and at the same time provide decent pay to workers.

In a typical factory, you might find a $60,000 machine that can sew on a back jean pocket in 10 seconds. I'm proposing a factory with a $6,000 machine that takes a bit longer but is more flexible—and a 15-person factory that costs $500,000 to set up and sells to individuals, rather than a $20-million one that employs a thousand people and ships products all over the world.

Besides being local, this sort of factory can make jeans that fit. I've talked to hundreds of women—tall, short, slim, curvy—and they all say the same thing: "I'm hard to fit." The fact is, it takes around 400 different sizes to offer every woman a perfect fit, not the 20 or so traditional manufacturers can crank out and the far fewer most retailers can afford to keep in inventory.

The good news: it only takes five measurements to determine which size fits almost anyone—and these don't even require a measuring tape. If a woman knows her height, weight, shoe size, and bra size, plus the size of her current favorite jeans, we can find the perfect pair for her.

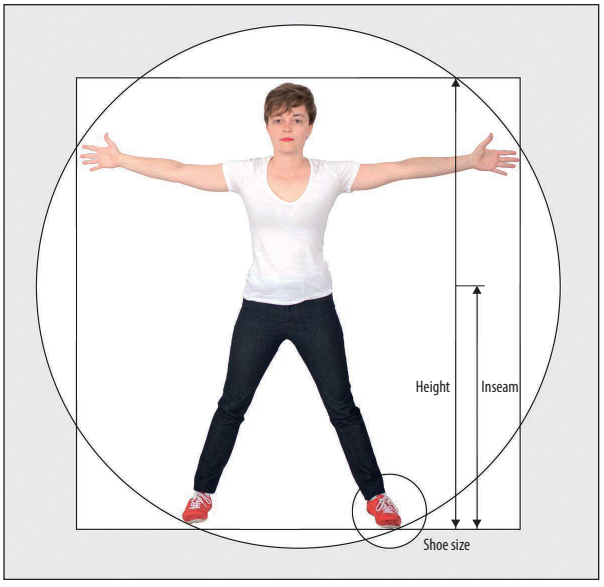
How is it possible? I wouldn't have believed it myself, but my partner, Gerald Ruderman, invented and built this system for a little denim company you may have heard of (say, "she vies"), but they killed the project during a big push to move all factories overseas—dismantling a whole production line they'd worked years to set up. I don't think they knew what they had.

Right now, custom jeans are a luxury item. They're made by hand, so they typically take months to manufacture and cost upwards of $700. I'm looking to hit a sweet spot between custom and mass-produced that will deliver the same level of fit, cut to order in a customer's size, but with much faster turnaround and for far less—under $200.

Selling directly to the consumer on my website allows me to customize the fitting experience and offer 400 sizes instead of the usual seven. We're working now to perfect the fit-model, collecting data on 1,000 women of all body types. Our data scientist is developing an algorithm that takes the five measurements and picks out which among our 400 size options matches the customer.

The garment is made-to-measure according to the customer's precise specifications at the time of order, so there's no inventory. Also there's no retail markup, which accounts for as much as 70 percent of store prices. This allows me to pay a bit more for production costs—the jeans are made in the US by a company that provides standard wages and good working conditions—and offer free

Crystal Beasley, *CEO of QCut, has 15 years' experience designing websites and interfaces people love, having done everything from herding LOLcats at ICanHasCheezburger.com to murdering password frustration at Mozilla Firefox. Visit her website at http://qcut.co.*



QCut plans to offer perfect-fitting, direct-to-customer jeans in 400 sizes based on five measurements. An algorithm will be used in making the match.

shipping and a stellar return policy, while still coming in at a competitive price point.

Lean manufacturing, a production philosophy which seeks to eliminate all waste that doesn't provide a direct value to the customer, is nothing new in industries like cars and microprocessors where labor represents a small fraction of the sales price. In the traditional apparel industry, though, optimizing factories in this way hasn't made sense. The new breed of companies embracing the mass-customization trend, like Qcut, are using the lessons of lean manufacturing to enable new business models that make to order and ship out in a matter of days, not weeks. Eventually, a network of small factories like these around the globe could represent a nimble new model of making, one customer at a time.

This is where slow fashion can compete. It doesn't matter to the maker what big-volume mass manufacturers are doing. We make our tomato the most delicious one.

Emmie's Lunchbox

Emmeline Parsons

My name is Emmie Parsons. Last year, when I was 8, one of my greatest dreams was to have my own laptop. I desperately wanted something to communicate with and to build in. (I wanted my own city, too, but I'm still working on that.)

So one day, my dad and I were looking online for a project, and he showed me a video he'd found. It was about a minicomputer called a Raspberry Pi. He told me we should totally build one. I agreed, very sincerely.

We worked out the idea to build the Raspberry Pi inside a lunchbox. We could carry it around easily, looking normal (or at least sort of), and then flip it out wherever we found an outlet. We started to go on some of our favorite sites, browsing until we found a keyboard that fit our dimensions (we had to measure lunchboxes beforehand). We figured we would do a demo Pi first, in case we made mistakes.

Once we found all the components, we went to the candy store and bought our boxes. I got Star Wars, and my dad got My Little Pony (which confuses people most of the time.) First, we had to figure out where everything fit. There were a few small catastrophes, but everything turned out all right. Next, we put Velcro on little wood bits to stick the screen inside. Then we bolted the circuit board behind the screen, and plugged in millions of cables. Surprisingly, the hardest part came next: cutting holes through the metal for the Wi-Fi chip, the USB, and the power supply. But after testing, we found they didn't fit, so we had to make them bigger. After that, all we had to do was the finishing touch—the keyboard. We Velcroed that in too. It took, altogether, about a week of evenings to actually build.

If you want to build your own minicomputer lunchbox, here's a list of everything we used (which we ordered online from Adafruit, SparkFun, and MCM Electronics, or bought at our local electronics store in Berkeley, Al Lasher's):

- Raspberry Pi, Model B;
- 7-inch HD multimedia interface flat screen (1280 × 800 resolution);

***Emmeline Parsons** lives with her cat, Legos, skateboard, and archery equipment in Berkeley, California.*

Emmie and her dad display their minicomputer lunchboxes. They used Velcro to attach the screen inside the lunchbox; the circuit board is bolted behind the screen. On the right, Emmie's playing a beta version of *Minecraft*.

- HDMI cable;
- miniature Wi-Fi module;
- 4-port bus-powered USB hub;
- 12-volt 2-amp and 5-volt 2-amp power supply (12-volt for the screen, 5-volt for the Pi; neither of us is an electronics expert, so my dad and I asked somebody who was, to make sure we were doing this part safely);
- 9.25-inch mini USB keyboard (remember, the dimensions are important); and
- some plugs and things.

For tools, we didn't have anything fancy, so we just used some wood, screws, Velcro, electrical tape, double-sided foam tape, a small hack saw, a metal file, and a drill.

After we built the prototype (my dad's), which took a week, it took another week to build mine—so all in all, only two weeks. I still can't believe that. I installed *Minecraft* (a game made up completely of cubes where you can build things with different materials), and started hacking in Python. And, of course, I also fulfilled one of my greatest dreams. That's not something you do every day.

Filmmaking's Transformation in the 21st Century

Melissa Pierce

Documentary filmmaking used to be a pretty straightforward process: you researched, shot, edited, exhibited at festivals—and prayed for a large production house or television network to take notice and buy your film. Those days, however, are long gone. Now that digital video is nearly indistinguishable from 35-mm film, and as the Web has proliferated, documentarians can create new models for storytelling and social impact.

When I made my first film in 2008, this paradigm was only beginning to unfold. Digital SLR cameras had just arrived on the scene (and were still suspect), crowdfunding hadn't yet come into fashion, and film festivals, ever weary of changing technologies, still accepted only 35-mm film reels. Even as indie filmmakers zealously adopted DSLR cameras, converting digital to film was almost as expensive as shooting to film directly, making it difficult for those without independent funds—or rich friends—to compete in the marketplace. Most filmmakers who shot DSLR went straight to DVD.

Fast forward to 2014, and the filmmaking industry, its audiences, and the impact of documentary storytelling have changed drastically. A variety of platforms are now

available—not only for self-distributing indie films, but also to spark audience activism around a film's social cause. And if filmmakers still want to go the traditional festival route, many of these now accept digital submissions for a nominal fee.

Crowdfunding via platforms like Kickstarter, Seed & Spark, and Indiegogo has made it easier than ever to find an audience and raise money before filming even begins. Such campaigns are now about much more than meeting budget; they've become a necessary element of a film's PR, and large distribution channels watch them closely to gauge a film's future profitability. My current project—*Born with Curiosity*, a film about computer pioneer Grace Hopper—was funded by people from all over the world whom I've never met but who were more than happy to donate not just money but information, time, and expertise. And, in fact, *Born with Curiosity* had several distribution offers before I'd even so much as conducted an interview.

With so many tools and distribution models available, documentaries have entered the realm of transmedia, mutiplatform storytelling franchises reserved until only recently for Hollywood blockbusters alone. It's now expected that filmmakers will tell their stories not just on a variety of platforms, but as different inter-relatable pieces. For instance, the film *Born with Curiosity* will relate Grace Hopper's life, but I've also been asked to create webisodes tracing the evolution of computer software, a blog about my learning Cobol during filming, a K–12 curriculum aimed at young girls, and a mobile video game with Grace as the protagonist. It's mindboggling!

Because more films are being created, and so many festival options are now available for selling finished films outright, the price movies command has dropped; indie filmmakers just breaking into the business will be lucky to break even.

But for documentarians like myself, any potential drawbacks of this new frontier for film are far outweighed by its potential to raise awareness and activate loosely distributed networks, all organized around a compelling social mission.

Melissa Pierce *is director of Chicago Women Developers (www.cwdevs.com), a nonprofit consortium "passionate about coding and … about women in tech," and producer of the forthcoming documentary* Born with Curiosity: The Grace Hopper Story *(www.indiegogo.com/projects/born-with-curiosity-the-grace-hopper-documentary). Contact her at contact@cwdevs.com.*

Dismissrr: A Line-Manage Service for Schools

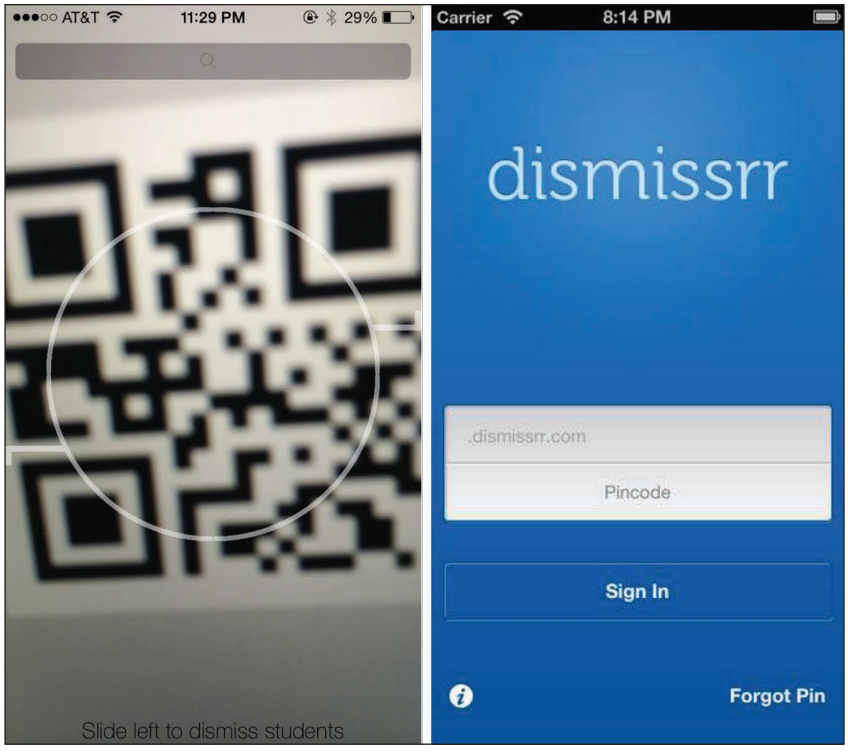
Sam Baumgarten

When people consider innovation—creating and developing new ideas and concepts—they generally think of large tech companies and their products, patents, and technology. But innovation really happens everywhere: when ideas are built on top of one another, when new things are discovered, when innovators communicate. My company Dismissrr (https://dismissrr.com) represents the epitome of an innovation built on other innovations. It's a product made by bringing many other ideas together, and like many other innovations, it has had to substantially evolve over time.

Dismissrr is designed to help schools manage their end-of-day student pickup procedures. The service is powered through iOS devices, QR codes, static-cling decals, and cloud computing—none of which I had any part in inventing. However, by putting them together in a unique way, I created something brand new.

Here's how the system works. Each family places a static-cling parking sticker on the windshield of their car. As the driver goes through the pickup line, a school staff member scans the unique QR code printed on each static-cling decal using a handheld iOS device. Once the barcode is scanned, a request is sent immediately up to the cloud, where all the students going home in that car—whether family members or carpool riders—are identified. Students waiting inside the school can then see their names come up on screens and be dismissed to go to the curb to get in their car. As they leave, another iOS device is tapped to find the students' names and remove them from the queue.

I came up with the idea for this system when I was in eighth grade. It was after the first day of school, and the new principal was having an extremely difficult and stressful time managing student pickup. At the time, the dismissal system involved each driver placing a card with the family name on the car's dashboard. A staff member would read the names into a walkie-talkie as cars reached the pickup point. But walkie-talkies can be hard to understand and can't keep track of which names are called. So another staff member had to yell out the names as they were announced on the handset while yet another was in the quad writing the names of all the families called on a whiteboard, at the same time that students were running around. I thought this system was very inefficient and disorganized and, therefore, a bit unsafe.



Dismissrr is an iOS device- and cloud-based system that helps schools manage how students are dismissed for pickup after school, based on when their rides arrive.

That night, I put together a basic prototype of my idea and pitched it to administrators the following day. Over the next year or so, I revised the system until it was finally ready for actual use. The following year, the system was implemented, and it has been in use ever since.

Dismissrr itself was an innovation; however, it has had to keep evolving. The initial versions were software that I licensed to run off a school's existing IT infrastructure. Unfortunately, as I found over time, most schools don't want to deal with maintaining servers. When I learned this, I decided to move Dismissrr up to the cloud and sell it as a monthly managed service. Innovations have to keep improving or else they will fall behind. Dismissrr is no exception.

The key to innovating is being unique. If you and your invention are unique, you're an innovator. While Dismissrr hasn't introduced any new technologies to the world, it's still an innovation because it brings many other ideas together to solve a problem that hadn't been solved before.

I founded Dismissrr three years ago, and it's received a great deal of interest and allowed me to travel across the US to pitch it. Dismissrr is one of many things I've invented, and I'm sure there are many more innovations and inventions in my future.

Sam Baumgarten *is a high school student from Palo Alto, California. He has founded multiple companies of his own in addition to working with others ranging from startups to large corporations.*

Helping Startup Communities around the World: World Startup Report

Andrius Neviera

World Startup Report provides a wealth of information about doing business abroad that nonnatives rarely have access to, offering reports tailored to specific countries that can help entrepreneurs initiate startups in those countries.

If tomorrow you were to start a business in another country, what would you need to know up front? Where would you go to search for that information? How many sources would you have to consult? And how many of these would be useful to you as a nonnative, and applicable to the country and its specific culture?

World Startup Report was established to address these concerns. Conceived in 2012, WSR began in earnest in 2013 when its founder, Silicon Valley entrepreneur Bowei Gai, boarded a flight for a trip that would eventually take him to 29 countries and 36 cities. Along the way, he met more than 6,000 people, visited multiple companies, and gathered considerable information about what's happening outside Silicon Valley.

After more than nine months, Gai settled in the Philippines, hoping to share his knowledge with the entire world. Some of his more interesting insights: in Nepal, the top mobile download is a scheduling app for planning when the electricity goes out across the country; in Kenya, the main mobile cash transfer platform stopped using the local currency for valuing transfers, using instead a percentage of the country's GDP as its metric. These and many other interesting facts about doing business in a particular country are rarely available to nonnatives.

I'm responsible for building a community of WSR Ambassadors, who gather such information in various forms: a country's legal environment, cultural differences, startup success stories, and more. They then put all this information together to create a country's individual opportunity map, showing different business models and their maturity level compared to the rest of the world. The WSR platform serves as a one-stop shop for the kinds of information entrepreneurs need about a country before starting a business there or expanding an existing business into a new market.

Recently, we needed to clarify some information about Iran. Within 24 hours, we were speaking with the country's most active startup community members, including investors and entrepreneurs, and compiling actionable data. We want to show the world that while much coverage is devoted to Silicon Valley, there's so much more happening outside it. The fact that so little centralized information is currently available just makes our initiative more challenging—and more interesting. Our goal—and how we define success here—is for the community itself to take over and become a self-sustaining organization. Eventually, we hope to see a cohesive international community driven by startup enthusiasts from every country on the map.

Leading the research at WSR has been an incredible experience. We've been featured in *The Economist* (www.economist.com/blogs/graphicdetail/2014/01/internet-startups), represent one of Slideshare's most viewed presentations (www.slideshare.net/worldstartupreport), and soon will be partnering with MOOC creators to spread our information through courses worldwide. We believe that our project—mapping all the startup ecosystems around the world—is unique and could become a global community-driven initiative like Wikipedia, but more narrowly focused.

In the end, if anything is worth doing, it's worth any mistakes made along the way. We just hope we'll get it right, bringing together a WSR community that can benefit the world.

Andrius Neviera *is COO at World Startup Report (www.worldstartupreport.com), a social project to help connect the different startup ecosystems worldwide. He is also lead organizer of Silicon Valley Comes to the Baltics (http://sv2b.com). Contact him at andriusneviera@gmail.com.*

Braigo: Building for Social Good

Shubham Banerjee

I've loved Legos since I was 2 years old. And last December in my family's mail I noticed a letter that said, "Help blind people with donations." This is how the two things came together.

I didn't know anything about braille, so I asked my parents how blind people read. And they told me, "Google it!" After some research, I discovered that the assistive technologies currently available are either too expensive or difficult to obtain for many people without government or nonprofit sponsorships.

According to the World Health Organization, there are an estimated 285 million visually impaired people worldwide, and 90 percent of them live in developing countries. At this moment, the cost of a basic braille printer is more than $2,000. Thus, many millions of people across the world have limited access to this technology. If we could reduce the cost by 75 percent, to below $500, it would be more widely available.

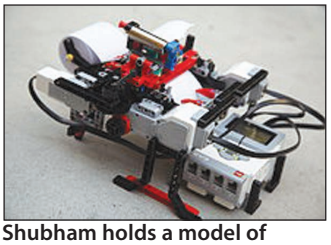
To make it possible for the masses to easily assemble a braille printer, basic do-it-yourself ability is key. The kit should be readily available in stores or procurable online from reputable websites to make the adoption process easy. Most printers operate in X-Y-Z coordinates—X, to move the print head; Y, to push the paper; and Z, to print or not to print. The printer also has to be compact and self-explanatory.

After studying the braille language, I understood that visually impaired individuals use their fingers to feel bumps on paper and other surfaces that are combinations of six dots. I decided that if we could make a printer that prints by making holes in paper as a mirror image of the letters, then by flipping the page, we should be able to translate letters into braille.

For my experiments, I used a common Lego Mindstorms EV3 robotics kit to build a DIY braille printer I imagined and programmed the device to print in braille. I worked with the constraint that all the parts for the printer should come from one kit, with maybe some low-cost readily available add-ons.

Using rapid prototyping concepts, I built models that I then programmed to see if I was able to get the results I wanted. I had to build and break up seven different models before I settled on a final one that was able to print six dots in the desired sequence according to the braille standards. After this, I programmed the letters A to Z. I used normal calculator paper to provide the proof of concept. I called my printer Braigo.

I've validated version 1.0 of Braigo along with some potential small software updates at the Santa Clara Valley Blind Center based in San Jose, and also working with Hoby Wedler—he's a blind doctoral student in computational chemistry at UC Davis. I'd say that the first prototype of the proof of concept has been successful. I achieved an 82 percent reduction in cost and have been overwhelmed by encouraging feedback from both sighted and blind people. By offering the building instructions and software as open source, I'll provide a low-cost printer alternative for the visually impaired community.



Shubham holds a model of Braigo, a portable braille printer he constructed using a Lego Mindstorms EV3 robotics kit. Below is a close-up of his model.

My dad was my guide whenever I got stuck even though he doesn't know much about Lego robotics. Sometimes his suggestions worked, sometimes not. He used to sit down with me evenings at the kitchen table, while he continued his conference calls and other business as I was building my models. For couple of weeks, I put in very long days. I'd start working on Braigo after I finished my homework, and some nights I was awake until 2 a.m. But it was all worth it.

I'm now working on Braigo 2.0, which I plan to market as a consumer product. Currently, my vision is for a braille embosser that retails for less than $200. If I could achieve that, it would be amazing.

You can read about my project and awards at www.wikipedia.org/wiki/braigo and at www.facebook.com/BraigoPrinter, where I regularly update the project's status.

***Shubham Banerjee** is a middle school student, inventor of Braigo, and founder of Braigo Labs (www.braigolabs.com), which focuses on creating innovative technologies for social good. Contact him at sbanerjee2001@gmail.com.*

WÜF: A Wearable Device for Dogs

Tyesha Snow

I believe in the potential of wearable technology, and at my company, WÜF (www.getwuf.com), we're striving to make a meaningful contribution to this wave of human–computer interaction. But we're coming at it from an unexpected angle: developing a wearable device for dogs.

We're making the world's smartest dog collar, and our mission is to create a deeper connection between people and their dogs. We combine GPS and Bluetooth technology, accelerometers, two-way audio, expert content, and a ton of data science to create what we hope will be the most satisfying, effective, and useful wearable ever—and not just for canines.

A lofty goal, I know. But as pioneers in product development, we think holding ourselves to high standards and lofty goals is essential, if not an ethical imperative.

With so many poorly designed, ill-conceived products on the market—wasting our time, creating frustration, missing opportunities for education and pleasure—I try to approach making by taking a "do no harm" oath, with an "advance humanity" cherry on top.

"Making" is a broad term, but one I like. "Make" is completely married to the idea of "use"; it's almost impossible to separate the two in one's mind. Unlike "produce," "engineer," or even "design," there's a power to the word "make." It elevates creation to a place of honor because what's created will be used.

Making is a great responsibility. Every decision involved in a product's design and engineering has a result. Think of the things you interacted with this week. Makers have the opportunity to create repeatable pleasure or pain, to save or waste time, to move people forward or backward.

When I was young, I thought I was an artist, I tried to be an artist—but I couldn't make a brush stroke or a scissor cut without obsessing over what the viewer would think. I could never shake that back and forth. And this isn't how good art is made: it's how predictable, clichéd, terrible art is made. (I'm embarrassed now just thinking of those pieces.) It is, however, how good products are made. So I lucked out and found my calling.

I think of the process of making as a conversation between the maker and the people who will use what's being made. This metaphor is helpful in every aspect of building a product or business. Each decision should occur in consultation with what you know about how that product or service will be used—not just functionally but also measuring value, ease, pleasure, and respect.

With that in mind, I'd like to share a bit about what we're making at WÜF. Hopefully, I'll inspire others to reflect on what they're building, and why—beyond that it's cool, it's possible, or it's going to make a lot of money.

At WÜF, we recognized that dogs are often the center of the family and home. Dysfunction and harmony alike spread from the dog throughout the family. We saw a ton of opportunity to engage technology here. But is getting into the middle of this centuries-old relationship really necessary? And who'd benefit most from the technology? The dog? Its owners? The relationship between the dog and its owners? Neighbors, the community, veterinarians, pet companies? We realized there are lots of conversations to pay attention to.

So we listened to lots of dog owners and uncovered one very common emotion: guilt. Guilt over not walking their dogs enough or leaving them alone too much or not knowing what to do in every situation. Then, we thought about this emotion and devised some ways to reduce it. Allowing owners' emotional needs to define the function, we're now making a collar that not only has activity-tracking and GPS, but also some things that are completely new: two-way audio and educational content tailored to and triggered by the animal's behavior.

Wouldn't it be great to know how your dog is feeling when you're away? In combination, movement information and audio can tell a lot about how a dog is handling your absence. If you discover your pet is experiencing separation anxiety, you can access easy-to-follow education programs to help in dealing with the problem. You can also set up alerts for excessive barking or crying.

Owners told us they often leave their dog at home when they don't want to worry about keeping the dog safe while enjoying activities outdoors, but leaving a loved pet alone makes everyone feel bad. So we invented the invisible leash, which uses audio cues to keep the family dog close, making it more enjoyable for family members to participate in outdoor adventures. We realize there's nothing like the feeling dog owners get when their dog is successfully off-leash. The dog feels confident, which

Tyesha Snow *is a user-experience designer from Portland, Oregon. For over 10 years, she's been working to build better products by more fully understanding people's relationships with technology. Contact her at hello@tyeshasnow.com.*

engenders good behavior and happiness, and owners can relax because the dog is safer than ever. Best of all, owners don't have to feel guilty for leaving their dog at home.

These are just a couple of things we're doing and how they came about. We're testing and improving our work every week, always with the dog–owner relationship foremost in mind. Our hardware revision cycles are aligned with our beta testing, and we'll continue to be governed by the voices of dogs and their families.

As technology advances, its products will affect our lives more intimately and profoundly. While not every product is destined to change the world, as makers we can create as though they could.

Experiments in 3D-Printed Design and Distribution

Carla Diana

Every few days, I wake up and check my online accounts to find that another of the toy sheep I designed has been created somewhere in the world. It may be in a library in Iowa or a garage in France or a classroom in Russia. Often the sheep just exists on its own, appearing as a photograph in my email or on an Instagram post. Sometimes it sits alongside a 6-inch-tall toy version of me, or a model of a character I call LEO, the walking, talking, 3D-printing robot—all objects I designed and prototyped in my studio and then distributed as files online.

Only a few years ago, this phenomenon would have been unthinkable. As a professional designer, I'm well-schooled in the ways of product manufacture and distribution. I've always known that, to appear anywhere but inside my studio, most designed items had to be mass-produced. For a design of mine to make it into people's hands, a mold had to be made, hundreds of thousands—if not millions—of parts had to be produced in bulk and assembled at a factory, and the finished items had to be packaged and stored in a warehouse. Then, they would make their way in trucks onto store shelves, where an end user could purchase one and take it home.

What makes my most recent collection of product designs so different is that none have gone through the typical manufacture and distribution process. I created them to be made on a 3D printer; their files are available online either through a popular 3D file-sharing platform like Thingiverse (www.thingiverse.com) or via a service that can 3D-print files and ship them to customers.

I didn't have to wait months for factory-tooling methods and logistics or depend on a client investing tens of thousands dollars, gambling on the success of my design. Instead, I created the parts for my toy sheep in my two-person studio and generated a virtual file to upload to a server; within as little as a day, my product was a real, physical object living in homes, schools, and offices around the world. The sheep files have been downloaded from Thingiverse over 2,500 times.

Is this process a new business model for designer entrepreneurs? Quite possibly, though it's still hard to tell. My first foray into the newly emergent 3D-printing economy was largely an experiment. I created a book to share my own excitement about 3D-printing technology and to illustrate several possible scenarios for printed-object design and distribution in the future. A book about 3D printing didn't seem complete without photos of actual 3D-printed objects, so I designed things like jewelry, planters, toy musical instruments, and chess pieces to fit with the characters and storylines I'd created.

While I was at it, I decided to make all the objects available to readers as free downloads. This way, they could hold what they were reading about in their hands, or reflect on the story later when they saw the objects on a desk or shelf. In writing the book, I considered the 3D data as much

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Carla designed and prototyped a 3D modern sculptural toy sheep (above left), then distributed files for it online; the original has been re-created by people all over the world. LEO (below left) is a walking, talking, 3D-printing robot from Carla's book *LEO the Maker Prince*. Carla also created a model of herself for her book (above right); it often accompanies her sheep in the photos people post. Other objects she created include toys and jewelry.

a part of the content creation as the text and illustrations. Although I'm not selling the objects per se, I profit from them as part of the book's larger context. Readers who don't have access to a 3D printer can acquire the characters and products featured in the story from a 3D-printing service such as Shapeways (www.shapeways.com), which uses my files to make the objects on demand and then ships them directly to customers without my ever having to touch inventory or handle fulfillment details.

What's even more exciting is that people can customize or modify what's printed, creating different colors or even shapes. When I first unleashed Carla and LEO's sheep on the world, it had a white body and black legs. I guessed that a black sheep would appear somewhere, and, sure enough, a devious-looking reverse-color version of my original design, created by a user in South Africa, showed up on Thingiverse within weeks.

Although I offered these files for free, my larger interest was experimenting to explore the world of globally distributed 3D files. Would people download the files? Would my designs work, from a mechanical standpoint? What would quality be like when I have no control over the type of printer and filament material used?

I'm still discovering answers to these questions. But for the most part, the answer to my main question—"Is it possible for a designer to develop physical products that can be multiplied and distributed digitally?"—is a resounding "Yes!" Naturally, though, making something like this work as a business requires that people pay for downloads, which means adopting an entirely new mindset from what we're used to. How much people are willing to spend and how makers can accurately determine value are questions still open for debate. But MakerBot (www.makerbot.com), the popular 3D-printer manufacturer, and 3DFileMarket.com are already selling files for download; in particular, MakerBot launched a new store last month that allows visitors to download files of toys and toy accessories. And since printers can be connected directly to the Internet, customers can even purchase a file online and have it immediately sent to their printer for fabrication.

Generally speaking, we're still pioneering 3D-printing file distribution, a situation many legal experts compare with the early days of MP3 sales. Because it's easy to copy and share files online, many sources for illegally downloading file copies will inevitably crop up. Another problem is that as 3D scanners become increasingly sophisticated, there'll be nothing to stop people from copying an object image, say a lampshade or small sculpture, and then producing a physical replica on a home 3D printer or through a 3D-printing service. But, then, why should there be?

As a designer whose livelihood depends on the value of intellectual property, I'm naturally concerned about the potential that digital replication holds for diluting that value. But I also see in digital replication even more enormous potential for empowering designers and entrepreneurs to start new businesses that would never have been possible before.

We still have a long way to go before a 3D-printed economy becomes reality. Now, objects produced through online services lack customized branding, and quality control is out of a designer's hands. Material selection is relatively limited, and parts are still more costly than if they were mass-produced. Moreover, if a product I've created is sold as a file for download and home 3D printing, I'll have absolutely no control over the material or even the printer a purchaser uses.

Nevertheless, the momentum is under way, and I can't wait to try out another experiment and see how a new set of designs travels from my computer and out into the world.

Builtbot

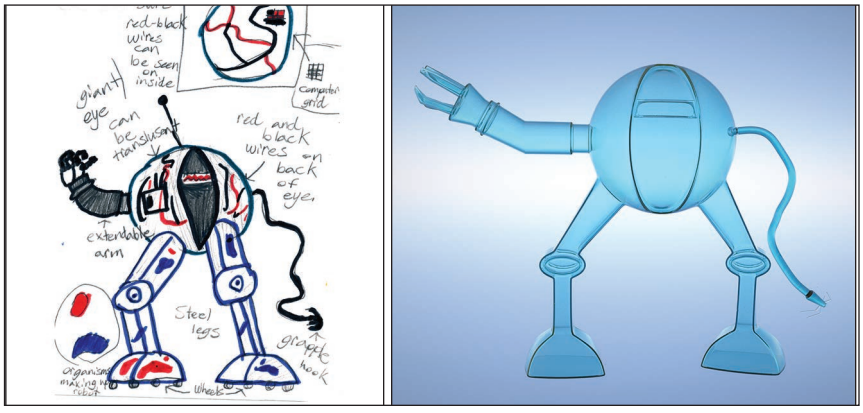
Nicholas Nakadate

Kids love robots. Kids also have great imagination and creativity. Combining the two is a goal of Builtbot (http://builtbot.com), which I conceived as a high-tech fundraiser for Chief Joseph/Ockley Green, a Portland public K–8 school that my 5-year-old son, Jackson, will attend.

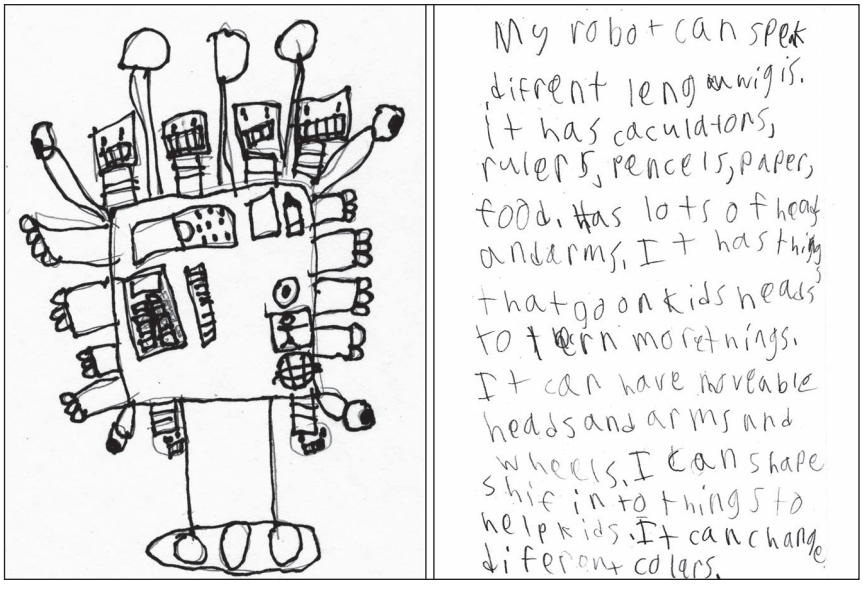
Builtbot bridges art and science with drawing and 3D printing. The Builtbot program has had a trial run supervised by art teacher Beth Bundy and science teacher Kristin Moon. Students in Ms. Bundy's three fifth-grade classes designed robots, but not just any robots. They first had to describe how the robot they drew would help them or someone else in their lives.

Once the robot designs were complete, we selected several to 3D model and print using the MakerBot Replicator desktop printer in Ms. Moon's classroom. Additional 3D printing took place at ADX (www.adxportland.com), a local workshop. The process showed students the challenges involved in 3D printing but, more importantly, helped to demystify how robots are made by personalizing the various steps. Participating in the project helped me begin to answer the question, "Where will all the robots in our future come from?"

Currently, Ms. Bundy, Ms. Moon, and school principal Molly Chun are working with Builtbot and ADX on a proposal for a pilot STEM program at Chief Joseph/Ockley Green that aims to span all grades and challenge students in designing and



Students at Chief Joseph/Ockley Green public school in Portland described and designed robots that were 3D printed.



Kids imagine and draw, shape, or model robots based on their idea of how the robot will help them or perform a task.

Nicholas Nakadate *is a visual effects artist for feature film and commercials, now working on a variety of interactive, animated, and VFX projects in Portland, Oregon. Nick's son, Jackson, is an energetic advocate for bringing drawings and digital art to life through 3D printing. Contact Nick at nick @builtbot.com.*

making. Potential media for the program includes clay, Legos, the Arduino platform, and more.

After seeing the test 3D print of the beetle-building robot he'd designed, Jackson was happy. "It takes a long, long time to make a real robot," he said, "but drawing them is fun. I want to make more!"

Get involved at Builtbot, and help make Chief Joseph/Ockley Green students' futures—and yours.

Reusing Gray Water: Becoming a Maker through Open Source Hardware

Shruti Satsangi

Bangalore presents a day-to-day dichotomy. On one hand, the city is known as the Silicon Valley of India and boasts of millions of IT workers performing state-of-the-art R&D. On the other, lack of access to basic amenities and inadequate overall infrastructure remain major problems that still need solving.

Facing one too many water shortages at home, I recently got the idea of finding ways to reuse water as a way of reducing our household water consumption. This presented a unique opportunity to use open source hardware in tackling one of the basic resource issues facing the city: lack of water.

I designed a system in which relatively cleaner sources of household waste water—from the shower and washing machine, for example—could be stored with minimal treatment for our own reuse before being directed to our housing complex's more expensive gray-water treatment facility.

I'd been introduced to the Arduino programming environment (www.arduino.cc) and the open source hardware movement earlier last year. So when I started looking for ways to quickly prototype a gray-water reuse mechanism for our home, Arduino came to mind immediately as the perfect solution.

The prototype was built entirely on the Arduino platform within a week. It consisted of an Arduino Uno board hooked up to a pH sensor, a temperature sensor, and a motor to operate a makeshift butterfly valve in our plumbing. We used this simple control system to redirect the flow of "clean" water (water with pH between 6 and 7) to a separate storage tank. We used this water for household purposes like mopping floors and cleaning bathrooms as well as outside the house—for gardening, washing the car, and so forth.

With four adults and a 6-month-old living in one home, we managed to recover almost 250 liters of reusable gray water a day. I'm now in talks with our apartment owners' association to deploy the system into more apartments in our complex. This move will make our housing society a little less dependent on water tankers.

Open source hardware is really a boon to anyone who has an idea, like I had, helping to quickly prototype and implement a project at minimal cost. For India, which faces significant infrastructure and resource challenges posed by a rapidly growing economy and expanding urban population, such technology can be used to quickly create solutions for pressing problems.

I hope by sharing this story I can inspire others to consider open source hardware as a means to find creative solutions for environmental problems. Making really is about the power of one person to take responsibility in bettering the world for everyone.

If I can do it, anyone can.

Shruti Satsangi *has extensive industry experience driving technical innovation projects ranging from telecommunications to the Internet and digital media. She is a member of IEEE Women in Engineering and the IEEE Communications Society, and is on the advisory board of the Grace Hopper Conference, India. Contact her at shrutisatsangi@gmail.com.*