PHOTO 1
My parking ticket, train ticket, subway pass, and event pass each used a different data technology. Some day we may get it all together. E-ZPass anyone?

A Visit to the World Maker Faire

In September 2013, Jeff traveled to New York City to attend the World Maker Faire, an annual convention for hackers, makers, and DIYers. In this article, Jeff shares some interesting maker projects and unique 3-D applications and provides some insight into the future of technology.

Jeff Bachiochi (US)

The car gently rocked to the clickity-clack of wheels rolling over rail joints. The image of my world was limited to mysterious silhouettes that flit past the window. It was easy to daydream at night due to the lack of visual stimulation. The lonely parking lot I had just left was devoid of life except for the lone machine that offered up a receipt when I fed it the appropriate currency. I had printed my round-trip Amtrak ticket at home. Its 2-D QR code image contained my reservation information. The conductor's hand-held reader confirmed my legal authorization to ride train #143 for the next 2 h and 42 min.

When dawn began to breathe life into the day, most passengers were unaware of the change as the open Wi-Fi had already taken them hostage. And then, in a flash, it was black. We were descending into a massive tangle of railways, subways, sewers, and utilities all built beneath the foundations of a thousand buildings and streets that make up

the "Big Apple." From the railway at New York City's Penn Station, you can make subway connections without ever seeing daylight. A swipe of my MetroCard gave access to the 7 train and an hour-long ride to the 111th street station. From there I joined a pilgrimage en route to the New York Hall of Science, which was host to the fourth annual World Maker Faire New York. At the entry gate, my 2-D data matrix image was scanned on my Maker Faire ticket (see **Photo 1**). Ahead were acres of makers, who served up a fun and educational experience.

WORLD MAKER FAIRE

The World Maker Faire is part science fair and part country fair. Makers are DIYers. The maker movement empowers everyone to build, repair, remake, hack, and adapt all things. The Maker Faire shares the experiences of makers who have been involved in this important process, which for so long had been lost or repressed. Social media keeps us in constant contact and can educate (e.g., through Google and YouTube videos), but it can't replace the feeling you can get from hands-on live interaction with people and the things they have created.

It should be noted that not all Maker Faire exhibitors are directly involved with technology. Some non-technological projects on display included the "Art Car" from Pittsburgh, which is an annual revival of an old clunker turned into a drivable art show on wheels. There was also the life-size "Mouse Trap" game, which was quite the contraption and just plain fun, especially if you grew up playing the original game. Note: Its size requires a trailer truck to move it between venues. Right next to the "Mouse Trap" were the famed "Coke and Mentos" fountains. I can't believe these guys have made a living off of 140 bottles of spraying fizz.

HACKERSPACES

How many of you have wanted to start a project only to be foiled by not having the right tools or expertise to pull it off? Hackerspaces are groups of like-minded individuals who pool their resources and provide a community-operated place where members can come to teach, learn, and have access to tools to turn their dream projects into reality. Each facility is usually sustained through donations and yearly membership fees. A list of established hackerspaces is available through Wiki (see Resources).

Many hackerspace members exhibited samples of their ongoing projects at the Maker Faire. Among them was Andrew Lloyd Goodman, an electronic media artist from Providence, RI. Goodman demonstrated the "Hammer Project," an RGB LED array embedded into the head of a wooden sledgehammer. A user strikes a horizontal "bulletproof" glass surface, which can be scattered with items to destroy. An open-shuttered digital camera (on the other side of the glass) records the mayhem. Some results are available on Goodman's website (see Resources).

The 721st Mechanized Contest Battalion (MCB) is an amateur radio club from Warren County, NJ, that combines amateur (ham) radio with electronics, engineering, mechanics, building, and making. The club came to the Maker Faire to demonstrate its Emergency Antenna Platform System (E-APS) robot. The robot, which is designed for First Responder Organizations, will turn any parking lot lamppost into an instant antenna tower (see **Photo 2**).

PHOTO 2
This pole-climbing robot is easy to deploy at a moment's notice. There is no need for a ladder to get emergency communication antennas up high where they can be most effective.

PHOTO 3
Andrew Plumb showed me some unique ideas he was experimenting with using one of his 3-D printers. By printing the structural frame directly on tissue paper, ultra-light parts are practically ready to fly.

PHOTO 4
Rhode Island's 3D Printing Providence group displayed several 3-D figures. The figures were printed using some rather different materials, which gave the impression that the objects are made of wood or stone.

3-D PRINTING

Working by day as an analog/mixed-signal IC design engineer for Cortina Systems in Canada, Andrew Plumb needed a distraction. In the evenings, Plumb uses a MakerBot 3-D printer to create 3-D designs of plastic, like thousands of others experimenting with 3-D printing.

Plumb was not satisfied with simply printing plastic widgets. In fact, he showed me a few of his projects, which include printing plastic onto paper and cloth (see **Photo 3**). I guess that's what happens when you've been doing 3-D printing as long as Plumb has. His collection of printing devices began with an early MakerBot Cupcake (he has one of the first 3-D printers, serial number 0009).

Matt Stultz, from Rhode Island's 3D Printing Providence group, brought his experience in multi-material and advanced materials to the Maker Faire (see **Photo 4**). He gave a talk at the 3-D printing stage about some new materials, including high-impact polystyrene (HIPS); Laywood, which is a type of PLA embedded with wood fibers; and Laybrick, the PLA infused with chalk dust to emulate a stone texture.

3-D MISCELLANEOUS

By far, the majority of groups at the Maker Faire demonstrated some kind of 3-D printing. Others, while keeping with the 3-D theme, took different paths.

Tarrytown, NY-based Dave Seff is a Linux administrator by day, and a machinist once the sun goes down. Seff's Solar1 project uses 3-D printing and CNC machining technology to manufacture custom parts, gadgets, and items. His fully functioning CNC plasma cutting table was on display at the Maker Faire. A fire extinguisher is always at the ready in case sparks fly. Naturally, Seff machined all his own parts for the plasma cutter build and his 3-D printer, which he nicknamed "Steel Bug."

It was just a matter of time until someone introduced a personal scanner to create digital files of 3-D objects. The MakerBot Digitizer Desktop 3-D Scanner is the first I've seen (see **Photo 5**). It uses a laser, a turntable, and a CMOS camera to pick off 3-D points and output a STL file. The scanner will create a 3-D image from an object up to 8" in height and width. There is no third axis scanning, so you must plan your model's orientation to achieve the best results. Priced less than most 3-D printers, this will be a hot item for 3-D printing enthusiasts.

PHOTO 5
The MakerBot Digitizer Desktop 3-D Scanner is the first production scanner I've seen that will directly provide files compatible with the 3-D printing process. This is a long-awaited addition to MakerBot's line of 3-D printers. (Photo credit: Spencer Higgins)

OTHER INTERESTING STUFF

The Public Laboratory for Open Technology and Science (Public Lab) is a community that uses inexpensive DIY techniques to investigate "environmental concerns." For instance, the New York chapter featured two spectrometers, a you-fold-it cardboard version and a near-infrared USB camera-based kit. This community of educators, technologists, scientists, and community organizers believes they can promote action, intervention, and awareness through a participatory research model in which you can play a part.

Over the last few years, Arduino has become one of the fastest-growing microcontroller-based platforms for electronics enthusiasts. TinyCircuits thinks smaller and lighter is better. And so, the TinyDuino was born. This ultra-compact Arduino is 20 mm square (or round) with a miniature stacking connector that supports the typical expansion header signals (see **Photo 6**).

Tiny add-on shields offer Bluetooth, Wi-Fi, USB, sensors, display, and motor drives for your swarm of robots or airborne payload. The board-to-board stack-up height is only 3 mm.

Chris "The Carpenter" Robinson, runs Rocket Brand Studios from Cape Cod, MA. His goal is to provide educators with an inexpensive robotic platform that can be used to teach a basic robotic class. "I spent several months designing and perfecting the 'Tadpole' based on the requests I heard: Simple, non-solder, inexpensive, and with room to expand capabilities in the future," Robinson explained.

A basic non-microcontroller platform costs less than $30.

Jackson, WY, is home to Cultivar, a company that is developing and manufacturing RainCloud, a web-connected irrigation system and application platform. RainCloud links mobile devices to lawns, gardens, and plants by combining automated water valves, soil sensors, a Wi-Fi-enabled programmable computer, and custom web applications.

Like many startups, Cultivar is using Kickstarter to test the waters for this project, which includes a latching DC solenoid valve, a Decagon Devices EC-5 soil moisture probe, and a Raspberry Pi microcontroller (see Resources).

Plantation, FL-based TeraBatt uses hybrid battery technology to store energy collected in the most efficient way possible. For instance, a home generator is designed for maximum efficiency at one output, anything less and you're not running at peak efficiency. TeraBatt's technology draws a constant output from the generator, enabling hybrid batteries to charge at the generator's peak efficiency. Your house then uses an inverter to draw from these batteries, which maximizes this conversion efficiency.

Mixed-media maker and blogger Sarah Hodsdon (*Sarahndipitous*) was at the Maker Faire to engage attendees not with flashy electronics, but low-tech items already found in most homes. While her purpose is to foster an environment that will produce the "next generation" of makers one kitchen table at a time, it was our conversation that hit big with me. Our discussion included the "real cost of doing business," which is an important change in attitude that is sure to become an issue as we move beyond the oil age. I urge you to read her blog entry "The Cost of Business" (see Resources).

Asheville, NC-based Beatty Robotics is not your average robotics company. The Beatty team is a family that likes to share fun robotic projects with friends, family, and other roboticists around the world. The team consists of Dad (Robert) and daughters Camille "Lunamoth" and Genevieve "Julajay." The girls have been mentored in electronics, software programming, and workshop machining. They do some unbelievable work (see **Photo 7**). Everyone has a hand in designing, building, and programming their fleet of robots. The Hall of Science is home to one of their robots, the Mars Rover.

HACKER COMMUNITIES

As I alluded to earlier, while hackerspaces are a new concept to many, they have been in existence for years. I remember when the media coined the term "hacker" as someone who illegally accessed a computer system by circumventing its security. Early arrests for this crime often resulted in hiring the perpetrator to take advantage of their expertise and improve security. While hacking can be used for evil purposes, most hackers just wanted to show off their talents. Thus the term is embraced by many to mean "a cleverness or skill in altering some equipment's intended purpose."

Today, "hacker" means "one with inexperience or unskilled." This defines the essence of a hackerspace or community workshop: A place where one can get experience and learn the skills necessary to complete a dream; a new kind of school. There are no sheep skins, just people seeking personal satisfaction.

Some organizations have taken the concept one step further. California-based TechShop began spreading its wings across America

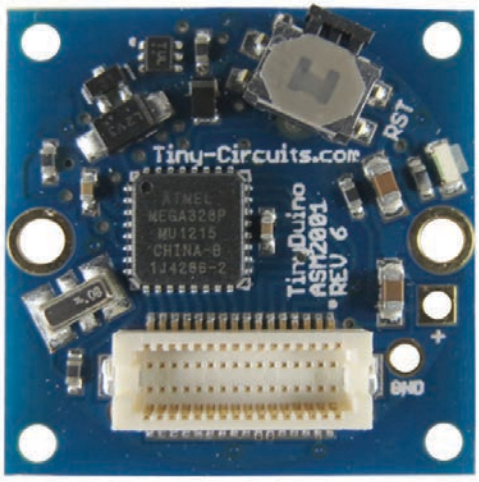

PHOTO 6
Designed with size and weight in mind, TinyCircuits's TinyDuino board is about the size of a quarter. It uses a high-density connector to enable the addition of compatible mini shield boards.

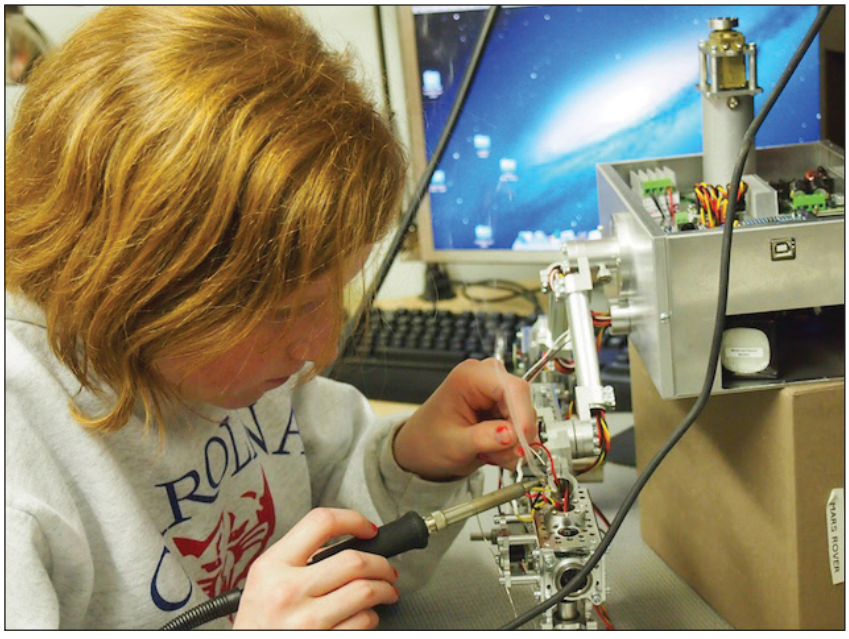

PHOTO 7
Beatty Robotics is a family of makers that produces some incredible models. Young Camille Beatty handles the soldering, but is also well-versed in machining and other areas of expertise.

ABOUT THE AUTHOR

Jeff Bachiochi (pronounced BAH-key-AH-key) has been writing for *Circuit Cellar* since 1988. His background includes product design and manufacturing. You can reach him at jeff.bachiochi@imaginethatnow.com or at www.imaginethatnow.com.

in 2006. Each facility includes laser cutters; plastics and electronics labs; machine, wood, and metal working shops; a textiles department; welding stations; and a waterjet cutter. Members have open access to design software, including the entire Autodesk Design Suite. Project areas with large worktables are available for completing projects and collaborating with others.

Under the TechShop name, anyone can participate in two areas: classes and membership. Classes are offered to members and non-members on a fee-per-class basis. You can become an annual or a monthly member. Membership enables you to schedule full use of any equipment in blocks of time, day or night. Other areas may include classrooms, offices, lounges, storage areas, and a storefront.

If you looked at the hackerspace website I mentioned earlier, you may have noticed there are plenty of independent spaces established other than the TechShop group. Most of these have originated via local meet-ups and other gatherings of those who get together to share their interests in a particular area (e.g., art, cars, photography, sports, recreation, technology, etc.). The groups may have started small, but grew as their popularity increased. If you're a designer, you know how expensive it can be to purchase the right tool for the job. These spaces have become local libraries for tools. In fact, I can foresee your local library being forced to morph into new covenants, or find itself unfunded as cities pare down their budgets.

What do Kickstarter, Indiegogo, and RocketHub have in common with community spaces? It's a new way of thinking. Crowdfunding puts you in front of people who want to buy your product, connect with you, and team up with you in many ways. Community and collaboration are at the heart of it. My town's local library is beginning to offer a variety of free classes. This is a great place to start, make connections, and form alliances.

CIRCUIT CELLAR CONNECTION

Many of you have been with *Circuit Cellar* since Steve Ciarcia started publishing in 1987. From that first issue, you knew what to expect: technical articles and projects by and for engineers, entrepreneurs, and hobbyists. As a world leader in electronic publications, Elektor International Media (EIM) recognized *Circuit Cellar* as the established engineering force in the US. A marriage brought *Circuit Cellar*'s gift of sharing technology to Elektor's world presence. This assured not only a continuation of the intensive, exploratory articles about hardware and software methods for embedded-control systems *Circuit Cellar* readers have enjoyed for years, but also broadened its outreach across oceans.

EIM is known for its passion for electronics. It has expanded its publishing services by offering an in-house design laboratory and PCB design department. I'd say EIM is taking steps to create a worldwide community of sorts, a place where like-minded entrepreneurs can go to bring their dreams to fruition. We are all makers. If we have access to the education and tools we need, there is no stopping our creativity. This is the stuff the future is made of.

PROJECT FILES

circuitcellar.com/ccmaterials

RESOURCES

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721st Mechanized Contest Battalion (MCB), www.wc2fd.com.

Beatty Robotics, http://beatty-robotics.com.

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