



THE
IDEAS FOR
DESIGN
 ISSUE

THE RISE AND FALL OF HEATHKIT— AND RISE OF SPARKFUN

Whenever I mention to folks that I used to work at Heathkit, a few of them ask, “What’s Heathkit?” Yes, I suppose that does date me a bit. Others will say, “Oh, yes, my dad used to build Heathkits.” Anyway, some of you do remember Heathkit, and fondly in most cases (see “Readers Reflect On Heathkit’s History,” p. 18).

The venerable company served generations of hobbyists and engineers alike of all ages. Its doors may be shut, and younger people with a technical bent seem to be drawn more to computers and software than to breadboards. But you still can build circuits and equipment yourself at home in your workshop, thanks to companies like SparkFun.

Just like those good old days, you can start with a design you cre-

ated yourself—or got from a magazine or Web site, such as *Electronic Design* (see “Whatever Happened To The Electronics Hobbyist?” at electronicdesign.com). You can buy resistors, capacitors, and transistors and put them all together on a metal chassis, a breadboard, or a finished printed-circuit board (PCB). It may be quite a project, but it’s still doable.

HEATHKIT'S HUMBLE BEGINNINGS

In the late 1940s and 1950s, someone invented the kit business. Companies designed a product and sold it as a bundle of parts called a kit. You could buy the kit for a fraction of what a comparable wired unit would cost and then build it yourself. The outcome was quite favorable—a workable electronic product and a great sense of accomplishment you got from the construction.

Heath helped start the kit business. Ed Heath founded the company in 1926 with, of all things, an airplane kit. He died in a test flight in one in 1935, but Howard Anthony kept the company going. Right after World War II, he bought a batch of electronic surplus. Out of that came one of the first successful kits, a small oscilloscope for \$50, which was a real achievement in its time. With that success came many new products (Fig. 1).

Heathkit probably succeeded more on its ham radio products than anything else. Most of the early kits were shortwave radios, transmitters, accessories like antenna tuners, and the famous Antenna, a 1-kW non-inductive power resistor in a paint can with mineral oil for the heatsink. Heathkit went on to create an extensive line of small and large transceivers and big power amps, many of which are still operational today.

THE SUCCESSFUL YEARS

Later in the 1950s and 1960s, Heathkit expanded into audio equipment, TV sets, and lots of other consumer products. The company even had a low-cost line of test equipment with scopes, multimeters, generators, counters, and other items. While Heathkit had competitors like Allied Knight, Lafayette, Eico, and a few other smaller companies, it essentially beat the pants off everyone else because it had a better product.

But Heathkit’s good reputation really came from offering a better assembly manual than anyone else.

2. Heathkit’s popular computer kits included the H8, which offered the H-17 dual-floppy option. (courtesy of Steven Stengel, <http://oldcomputers.net>)



1. Many engineers and hobbyists alike eagerly anticipated the arrival of the new Heathkit catalog in the mail. (courtesy of Richard Pestinger, www.pestingers.net/Catalogs.htm)

Features that make Heathkits the best kits...

- KITS THAT FIT:** Heathkits are designed to fit into a standard 19" rack or on a bench.
- BEST OF PARTS:** Heathkits use the best quality components available.
- PRECISION PARTS:** Heathkits use precision components for accuracy.
- MODERN STYLING:** Heathkits have a modern, professional appearance.
- COMPLETE KITS:** Heathkits contain everything you need to build the kit.
- LARGE EASY READ CALIBRATION:** Heathkits have large, easy-to-read calibration instructions.
- COMPLETE INSTRUCTION MANUALS:** Heathkits include complete, step-by-step instruction manuals.
- IDEAL FOR SCHOOLS:** Heathkits are ideal for use in schools and educational institutions.
- BEST OF ENGINEERING...:** Heathkits are built to last and are highly reliable.
- WHY NOT BUILD YOUR OWN...:** Heathkits are a great way to learn electronics and build your own equipment.

HEATH COMPANY · BENTON HARBOR, MICH.

New Fall FLYER HEATHKIT ENGINEERING FEATURES

- New PRINTED CIRCUITS:** Heathkits use printed circuit boards for better performance.
- New PEAK-TO-PEAK VTVM CIRCUIT:** Heathkits feature a new peak-to-peak VTVM circuit.
- New HIGH READABILITY PANELS:** Heathkits have high-contrast, high-visibility panels.
- New STYLING New Color:** Heathkits feature a new color scheme for a more professional look.
- New SCOPE SWEEP CIRCUIT 10 CYCLES - 500 KC:** Heathkits include a new scope sweep circuit.
- Continuing PROGRESS FUTURE LINE EXPANSION:** Heathkits are part of a growing line of products.

HEATH COMPANY · Benton Harbor, Mich.

1057 HEATHKIT SPRING FLYER

check your ignition system electronically for peak engine performance...

new HEATHKIT IGNITION ANALYZER KIT

The IA-1 features a digital display of voltage and light level values on a fluorescent cathode-ray tube screen. Since the readings are produced by a cathode-ray tube, they are accurate, clear, and easy to read. The IA-1 also features a built-in speaker for audio output.

Model IA-1 \$59.95

HEATH COMPANY · BENTON HARBOR, MICHIGAN

world's finest electronic equipment in kit form...

Heathkits for 1956

HEATH COMPANY · BENTON HARBOR, MICHIGAN

give HEATHKITS for Christmas

Useful and practical gifts for workhorses in your family

HEATH COMPANY · BENTON HARBOR, MICHIGAN



3. Even a child can build kits from SparkFun. Soldering is an easily learned skill.

A poorly executed step-by-step manual is a prescription for disaster for any kit company. If the customer can't build the kit successfully without massive telephone and mail support, the company would die a quick death, and many did. Heathkit figured this out early and spent as much development time on the manual as it did engineering the product. Its primary marketing message was "We won't let you fail," and the company lived up to it.

I went to Heathkit in the early 1970s to start its education and publishing product line. The idea was to extend the concept that building a kit was an educational endeavor and that we could expand on that idea with more formal learning materials to supplement the kits. We built a line of self-instructional courses on electronic fundamentals and a wide range of other topics.

READERS REFLECT ON HEATHKIT'S HISTORY

COMMUNICATIONS EDITOR LOU FRENZEL FIRST blogged about his experiences working at Heathkit in May 2009, when the company was still going strong as Heathkit Educational Systems, or HES (see "Whatever Happened To Heathkit?" at electronicdesign.com). He blogged again this May when he heard that the company had closed (see "Heathkit Closes, Again. This Time For Good?" at electronicdesign.com). Reader response to these blogs was huge, with many of you offering your own analysis of the company and its demise. Here are some of the comments:

"Yeah, I guess you are dating yourself, Louis, when you claim to be knowledgeable about Heathkit. I built a Heathkit shortwave radio and 'Q' multiplier in 1962, which I used for many years. I also have to agree that Heath provided the Cadillac of assembly/documentation manuals. Things just ain't the same as they used to be!"

"Sadly, no one has produced kits like Heathkit, and the little kits available now are not very good for system-level development. And not the same level of documentation. Very poor for this day and age. No wonder kids shy from electronics."

"Heathkit never adapted their product, kits and education, to changing times. Education took a lot longer to die, but it was a slow death from more adaptive competitors. Survival would not have been easy, but consider how Radio Shack, Elenco, and Jameco survived and continue to thrive.

HEATHKIT

- fun to assemble • easy to use
- big in savings • best in quality
- 7 complete lines—over 250 kits

STEREO HI-FI KITS, everything from source to sound.

MARINE ELECTRONIC KITS, for more fun, greater safety.

CITIZEN'S BAND RADIO KITS, the biggest and best line anywhere.

HOME & HOBBY KITS, to make in the easier, more interesting.

TEST & LAB KITS, for industry, service, and home workshop.

EDUCATIONAL KITS, for all ages, all purposes.

SPECIAL SALE
See page 47 for a list of Heathkits and accessories now at reduced prices. Big savings, limited quantities.

HEATH COMPANY, BENTON HARBOR, MICHIGAN
PLANT LOCATION, ST. JOSEPH, MICH.
A subsidiary of Radio Shack Corporation
CATALOG SUPPLEMENT 80/32

Local electronics stores too survived the carnage of such classics as Skycraft in Florida, Apex in California, and a multitude of small shops on Canal Street in New York City. New companies have grown selling kits and supplies, and the Internet and superb shipping companies have made access to components no longer dependent on the neighborhood electronic stores. If Heathkit folded, it can only blame Heathkit management and a willingness not to persevere."

"The Apollo program was exciting until we reached the Moon, then the thrill was gone. The Shuttle program was exciting until the Internet took off, then the thrill was gone. The iPad was exciting until the iPad 2 came out, then the thrill was gone. Now we have the iPad 3, and the thrill is already gone. Sure, the space program brought forth all sorts of technology, but as the saying goes, 'What have you done for me lately?'" The threshold of excitement is raised every time something new and exciting comes out, so the nostalgia over the exciting things of days gone by is only appreciated by those who lived the days gone by. I still like building circuits, but younger people just don't see the point in it. They can Google what I am trying to build and show me a thousand images of what other people have already built. Kind of takes the fun out of it."

Heathkit

FREE GIFTS
See back cover

Build our new kit picture-in-picture TV with premium stereo sound and full-featured remote control. Turn to pages 4 and 5.

Heath Company
P.O. Box 8589
Benton Harbor, MI 49022

A line of kit trainers accompanied the instructional materials.

The first products emerged in 1974 and were

instantly successful. We followed up with microprocessor learning packages, which were hot for their time. And, we developed the

Hero robot kit that came out in 1982.

I was also involved with developing the Heathkit computers (Fig. 2). We

created the H8 and the H11, not to mention the H9 terminal and the H10, a paper tape reader/punch. (What was I thinking?)

The H11 kit used Digital Equipment Corporation's (DEC) famous LSI-11 board. We packaged that into kit form with some

FUN AT SPARKFUN



"SparkFun started in 2003 by myself in a bedroom while I was a junior at CU and I realized that I needed some parts for some projects that I was building, and I realized at that point in time on the Internet it was kind of hard to find those parts," says Nate Seidle, founder and CEO of SparkFun. "So I saw the void and put together a website and starting selling bits and pieces in 2003 and here we are... nine years later, and we've grown quite a bit."

BACK IN APRIL, I VISITED SparkFun Electronics in Boulder, Colo., along with Curtis Ellzey of Engineering TV. I got to speak with a number of people there including Nate Seidle, founder and CEO of SparkFun Electronics (Fig. 1).

SparkFun Electronics is aptly named. The production and inventory facility is chock full of boards, components, and modules (see "SparkFun Electronics: Let Your Geek Shine" at engineeringTV.com). There are enough dogs and skateboarders roaming around to give the impression of Venice Beach rather than the mile-high city. The number of lab benches with projects strewn all around attests to someone having too much fun.

Often the projects are designed to test out or develop new products. SparkFun sells components as well as kits. The company has parts for all sorts of things from robots to Arduino boards and shields.

OPEN-SOURCE HARDWARE

Still, SparkFun is a business, and it's doing rather well. One of the challenges it made for itself is using open-source hardware (OSHW) in many of its products (see "SparkFun Electronics And Open-Source Hardware" at engineeringtv.com).

OSHW is used by a number of open-source projects as well as chip vendors that have dev kits and reference designs. The big difference between chip vendors and SparkFun is that SparkFun sells OSHW designs. The other vendors want to sell chips, modules, or design services. The actual OSHW design is inconsequential to them. It's a tool to sell more of their primary product.

This means SparkFun needs to be quick to market in addition to innovative. On the other hand, it also makes for very good customer interaction, allowing ideas to percolate quickly.



SPARKFUN SOLDERING COMPETITION

Many of SparkFun's products are kits you can build, which usually means soldering. Soldering tends to be a dying art from a manual standpoint with the rise of surface-mount hardware. It's possible to solder some surface-mount components by hand, and I've done it. I don't recommend it unless you're very patient or want to practice a lot. It's definitely not for production work. But hand soldering never was, at least in recent memory.

Still, soldering is a craft that can be useful and fun, hence the SparkFun Soldering Competition (see "SparkFun Soldering Competition" at engineeringTV.com). Now what could the company come up with for a soldering project? Why, SparkFun kits, of course. SparkFun has lots to choose from, and there were lots of entries at the first annu-

Not all of SparkFun's products are OSHW. The company sells lots of components and third-party products as well. The SparkFun catalog is quite extensive, although the experienced developer/bargain hunter might want to check out the Ding and Dent section.

You can pick up SparkFun's scrap for next to nothing. It's a great way to encourage hot-air rework, scoring usable parts, without fretting that the rework will go poorly.

1. SparkFun's inaugural Soldering Competition last April drew hobbyists and professionals from far and wide, squaring them against each other in one-on-one contests with a \$500 grand prize at stake.

2. Last June, teams gathered at the SparkFun Electronics headquarters in Boulder, Colo., to compete in the fourth annual Autonomous Vehicle Competition. Divisions included unmanned ground vehicles (a) and unmanned aerial vehicles (b).



8-in. hard drives (remember those?) and the RT-11 operating system with Basic—not bad for \$1200 at that time. The all-in-one H89 and others came later.

al competition held at Oskar Blues Homemade Liquids and Solids (Fig. 2). It's a beer and BBQ joint, so the suds were flowing along with the solder.

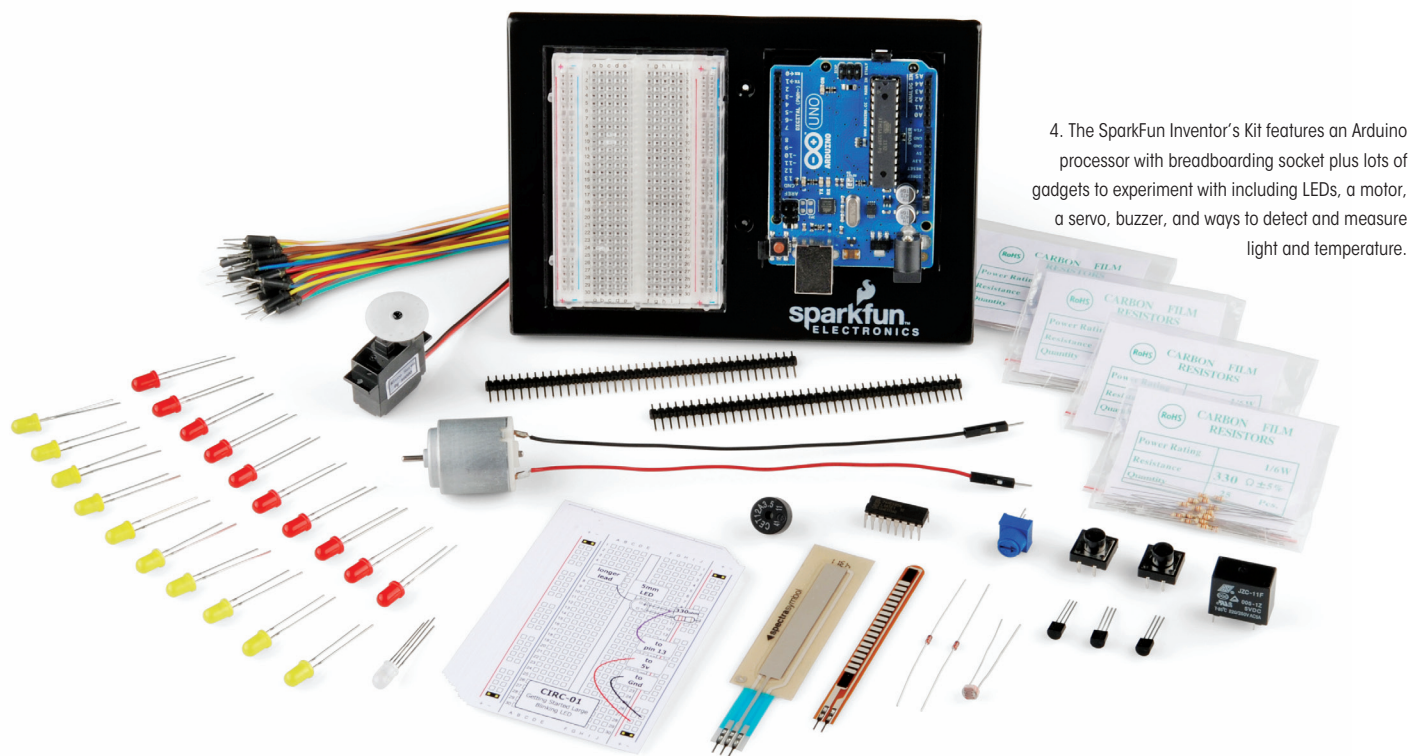
The soldering competition used a number of SparkFun kits of progressively more complex boards, including the Simon PTH Kit, the Big Time Watch Kit, and the Mr. Roboto Kit. The first place winner was Thad Larson with a total time of 23:20. John Sherohman was second with a time of 24:16, and third place went to Matthew Capron (31:45).

There were a couple of fun awards as well, including the Quality Award (Amie Paxton), Safety 3rd (Jessica Campbell), Style Award (Andrew Zirger), Best BYO Equipment (Aaron Rogers), and Ugliest Solder Joints (Eileen Egger). Rebecca Brunner, Andrew Zirger, and Alice Rowe took first, second, and third in the Kids Race.

Another competition to watch out for is SparkFun's annual Autonomous Vehicle Competition (Fig. 3). There are two divisions: unmanned ground vehicles (UGVs) and unmanned air vehicles (UAVs). Sorry, no quadcopters are allowed in the UAV group, only planes (see "SparkFun AVC 2012" at engineeringTV.com).

So if you have a project on the back burner or are just looking for some electronics fun, check out SparkFun at www.sparkfun.com.

BILL WONG



4. The SparkFun Inventor's Kit features an Arduino processor with breadboarding socket plus lots of gadgets to experiment with including LEDs, a motor, a servo, buzzer, and ways to detect and measure light and temperature.

MAKER FAIRE: A BREEDING GROUND FOR FUTURE EEs AND MEs

WHEN I ATTENDED MY first Maker Faire a year ago, I was quite surprised at the turnout and activities. Somehow I had in my head that Maker Faire would be more like a ham fest or small trade show. But Maker Faire is more like a county fair. The New York City version is held on the spacious grounds of the Hall of Science in Queens, N.Y., part of Flushing Meadows Corona Park, where you can still see vestiges of the 1964 World's Fair.

Maker Faire is a family event, so lots of youngsters were eagerly participating in the events. On the electronics side, companies like SparkFun Electronics and Radio Shack had their own tents. Both companies were giving away electronic kits and letting the kids and adults sit down at soldering stations to put the kits together. If you came to the fair not already proficient in soldering, there was a class you could attend to develop your skills. Both boys and girls were taking advantage of the largesse of these companies. I saw one girl using red goggles to protect her eyes while soldering—very fashionable.

One of the big trends at the show was 3D printing. There were all sorts of printers producing parts, statues, and other 3D pieces. Besides the equipment, companies like Shapeways were touting their services. A fellow at the station told me that if I could create a part with 3D software, the company could make it. Just send it the file.

Another trend was laser printing. Here, it seemed as though companies like Epilogue Laser were inviting you to start your own laser engraving business. They showed lots of examples of the possibilities, but my favorite was a dragon etched on the back of an iPhone, kind of like a mobile tattoo.

The Arduino open-source electronics prototyping platform also garnered a lot of attention, mostly from the adults at the show. Presentations were given during the day on various facets of the platform, which packed a large tent with seating for more than 100 people.

Mechanical brilliance was also on display at the fair. When I first arrived, I saw kids riding around on all kinds of bicycle/tricycle contraptions, with wheels going every which

way—very challenging to drive as far as I could tell. For pure entertainment, there was a life-size Mousetrap game and a medieval-type launcher that sent plastic bottles of water sailing a great distance through the air.

Of course there were robots at the fair. One was a giant fire-breathing dragon made from recyclable parts. There were lots of smaller ones on display, too.

Maker Faire doesn't just cater to electronic and mechanical activities. The fair also features arts and crafts and green living. I was able to convince my wife to attend by telling her that one of the sponsors was Martha Stewart Living.

The weather cooperated with a beautiful cool and sunny day, which made the fair atmosphere even more inviting. Of course, there was lots of food like you would expect at any county fair. The longest line was for the Asian hot dogs. You can view some of the photos we took at the fair on our Electronic Design Facebook page at www.facebook.com/ElectronicDesign.

JOE DESPOSITO

THE BEGINNING OF THE END

The success of the computer line attracted the attention of Zenith Corp., which went on to buy Heathkit in 1979 from the owner Schlumberger, an oil field service company that also owned Fairchild Semiconductor at the time. Zenith carved out the computer product line and started Zenith Data Systems (ZDS), which went on to build a several billion-dollar business making Zenith computers and PC compatibles. Groupe Bull of France eventually bought that business, and ultimately it succumbed to the market forces driving the PC-compatible business with all its shakeouts, ups, and downs during the late 1980s and early 1990s.

In the meantime, the kit business suffered. Zenith didn't really want it, but it came with the deal. It was neglected as ZDS grew, and so began its slow decline into oblivion. But a great deal of that decline had little to do with Zenith. It was also the time of great progress in semiconductor manufacturing. More and more equipment was being made of more and smaller ICs and surface-mount components, both of which were always a challenge for kit builders. It became harder to make a kit people could build at home with basic hand tools.

At the same time, wired products became cheaper thanks to Asian engineering and manufacturing. You could buy a great stereo or color TV set for less than what a kit cost, and you didn't have to spend three weekends building it. Everyone was into instant gratification in the 1980s, so nobody wanted to spend time building kits.

Heathkit discovered it could no longer compete in many markets like ham radio, audio, TV, and test

equipment as it took as much time and money to

create the manual as it did the product. With double the

development costs and the technology making assembly more difficult, Heathkit eventually concluded it could not compete. This perfect storm of conditions led to the formal phasing out of the kit business in 1991 and 1992. There was lots of editorial coverage about that being the end of an era.

The education and publishing business called Heathkit Educational Systems (HES) continued. While the courses, materials, and trainers were sold to individuals, HES also developed a huge college and university business. HES was soon sold to a private buyer. Its primary customers were educational institutions, though you could still buy individual learning programs and even the trainer kits. HES also retained the rights to all those amazing kit manuals, and it continued as a successful operation until last March when operations ceased.

When I left Heathkit in the early 1980s, Heathkit Educational Systems revenue had increased beyond \$15 million and the Hero robot really brought in even greater revenue. Heathkit's overall revenue was well over \$100 million at that time thanks to the kit computer business. Despite the success HES saw as a spinoff, the kit people and the ham radio people who originally were with Heathkit didn't run it. The education market required different knowledge and skills. That's probably why HES wasn't

successful in transitioning back to kits and ham radio.

Some of us ex-Heathkit managers had hoped HES would successfully get back into the game. But we all had our doubts because of that lack of real kit or ham experience. The name Heathkit is golden and would have helped the company make a comeback in the hobbyist/experimenter/ham arena.

In May, HES officially filed for bankruptcy. All operations have shut down and the business is no more. Some have tried to acquire the name and assets without success. It looks like it's gone for good. Fortunately, other companies have stepped into the market.

DIY KITS TURN HOBBYISTS INTO ENGINEERS

In fact, there seems to be a resurgence in the do-it-yourself (DIY) electronics marketplace. While electronics hobbyists have always been around, their numbers come and go with the times. It's also hard to determine why those numbers are going up lately.

Drivers include popular YouTube videos, magazines like *Make* and its *Maker Faires*, a growing interest in robots, and a batch of new kit companies (see "*Maker Faire: A Breeding Ground For Future EEs and MEs*," p. 22). All of these factors are spreading the word and generating interest in hands-on electronic experimentation.

That's good news for engineering. One of the main sources of engineers is the pool of hobbyists and experimenters (see "*Veteran Electronics Hobbyists Finding New Ways To Enthuse Today's Youth*" at electronicdesign.com). Given today's shortages, we can always use a few more good new engineers. Start your kids early (*Fig. 3*).

It is still fun and satisfying to build a kit. If you have the patience, you'll experience that "eureka" feeling one gets from building a particularly large and difficult kit. It works! It's a rare, satisfying experience that few enjoy anymore. Next time you want to encourage your kids or relatives to enter the electronics field, give them a kit.

Most kits go light on the newer parts and stay with older but still good ICs with the larger through-hole packages. When newer ICs are used, they're often pre-mounted on a PCB or the assembly using them will be pre-wired to prevent damage from poor construction.

Some smaller kits can be found at Ramsey Electronics (www.ramseykits.com), which offers a wide range of kits like power supplies and amplifiers that hobbyists love. Ramsey also has many ham radio kits and some commercial radio kits.

Jameco (www.jameco.com), which you might recognize as a mail order parts house, also has a line of small kits for hobbyists

and educational institutions. Some of the ham radio com-
panies offer kits as well, like Elecraft (www.elecraft.com), TenTec (www.tentec.com), DZKit (www.dzkit.com), and many smaller ones. Other sources include Elenco Electronics (www.elenco.com) and Kelvin Electronics (www.kelvin.com).

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LIGHTING THE SPARK

One of the new companies supporting this renaissance is SparkFun Electronics in Boulder, Colo. Its extensive line of kits and projects is serving the hobby market with more than 1800 products. SparkFun's main focus is embedded micros and all their related items, but it also offers parts and kits for almost anything electronic. The company's goal is to help individuals discover their inner inventor and enable them to create their own electronic products (see "Fun At SparkFun," p. 24).

Among other company initiatives, SparkFun's annual Free Day has brought it lots of new business. At this year's event, the company gave away \$200,000 worth of credit to 2000 lucky recipients to use at its online retail Web site. These individuals each got \$100 for parts, projects, and kits, feeding lots of interest, renewed experimenting, and learning.

SparkFun also focuses on education. The company knows that a huge part of any hobby is learning. Its online video tutorials, books, and kits provide

a wide range of educational activities. In addition, SparkFun recently created a department of education led by Lindsay Levkoff. It's designed to ensure that individuals can get the tools, knowledge, parts, and other resources they need to explore the world of embedded electronics.

"Our hope is that anyone interested in pursuing this exciting field will find the necessary resources and inspiration to play," Levkoff explained.


SparkFun hosts workshops on various areas of electronics technology including soldering, wireless, printed-circuit board (PCB) design, and prototyping. The company also partners with schools to foster excitement about electronics and technology in the classroom to help meet the national priority of improving science, technology, engineering, and mathematics (STEM) education. Hands-on experience with kits and projects is a great way to introduce students to a lucrative career in electronics or computer science.

SparkFun's products include the Simon Says soldering kit and the Arduino Inventor's kit. New electronics hobbyists quickly discover that they need to learn to solder. The Simon Says kit teaches that skill. It uses all through-hole components, though another version of the kit is available with surface-mount parts.

With the kit, users can practice soldering a 28-pin

microcontroller chip, LEDs, battery clips, and all the other usual components. Once you build it, you can play the game. You also will have a simple development platform for learning embedded controllers. There are five outputs for LEDs and a buzzer and five inputs for buttons and a serial port for debugging. The processor is an ATmega328, which is good for learning how to program Arduino products.

Another immensely popular kit is the Inventor's Kit for the Arduino processor, which is designed to teach users how to program the processor (Fig. 4). It's a good initial learning tool for embedded electronics. Projects include blinking LEDs, motor control, servo operation, making music, using the input buttons, implementing volume control, detecting light, reading temperature, and mixing LED colors. All the parts and an instruction manual are supplied.

If you're looking to educate your own kids or trying to get others interested in a career in electronics, SparkFun products and resources are an excellent starting point. 

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