Kits for Kids

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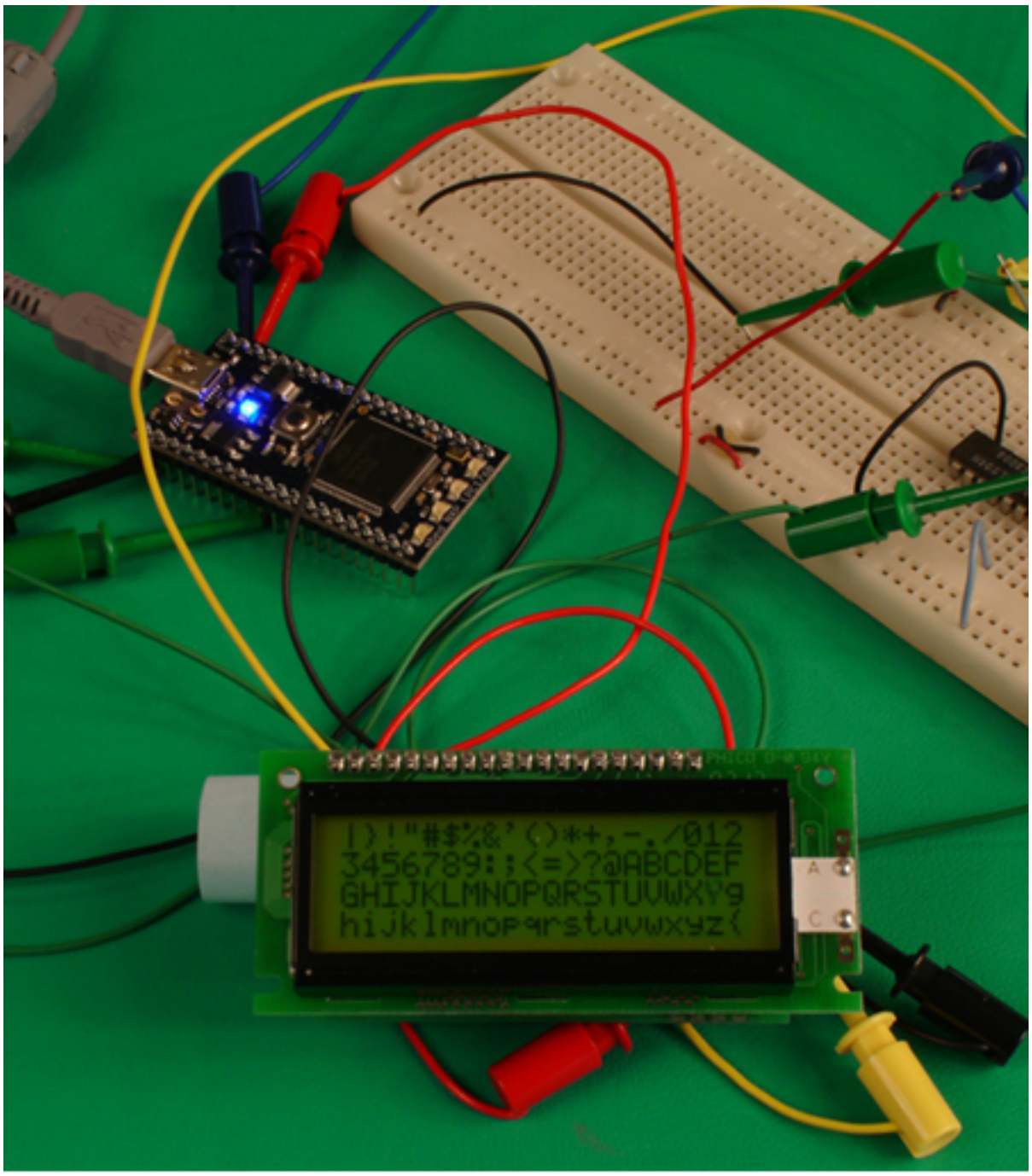
As a teenager, I built many "computer" circuits with relays and switches. As I recall, a flip-flop took two 2PDT relays and a binary adder took two 4PDT relays in my brute-force logic circuit. Kids today can get started exploring computers more easily.

Recently I took a close look at the mbed computer module that provides an ARM Cortex-M3 microcontroller and I/O connections for serial, I2C, SPI, CAN, PWM, and Ethernet ports as well as for analog I/O signals. The mbed module includes four LEDs that turn on or off under software control.

Unlike many computer modules that require host-PC-resident software tools, an mbed module takes advantage of an online C/C++ compiler and extensive libraries. The libraries simplify writing code and the extensive documentation provides examples of how to use library functions. I had an mbed module sending serial ASCII data to a Seetron LCD module in a few minutes. Because the mbed module appears as a USB memory stick to a host PC, the module requires only a simple USB cable (supplied) to download code and obtain power.



Art 1. It took only a few minutes, eight lines of code, and an inverter IC to have an mbed module display characters on a serial LCD.

The mbed Web site (www.mbed.org [1]) includes a blog, a handbook, and a repository of code and examples. The site also provides a "notebook" for each person logged in so they can save and share projects and programs. The online compiler lacks debug capabilities and people cannot print listings directly. They must cut and paste code into an editor such as Windows Notepad or WordPad and print from there. The mbed is available from many distributors for about $US 60.

I also recommend the book, "Practical C Programming," 3rd edition, by Steve Oualline, O'Reilly Media (ISBN: 978-1-56592-306-5) as a way to introduce teenagers

to the C language. Although the mbed examples often use C++ code, a young programmer can quickly figure out the syntax. Avoid books written as introductions to C or C++ that assume a reader will run examples on a PC for a PC. They rely heavily on keyboard input and printf() output statements for PC applications.

If your young computer enthusiast needs an inexpensive way to learn how a computer works, I recommend the cardboard Cardiac, or Cardboard Illustrative Aid to Computation, originally published by Bell Labs in the late 1960's. Cardboard sliders position information in windows for a program counter, accumulator, and accumulator-test register. Cardiac has 100 "memory cells," but a pad of paper extends memory almost indefinitely. You can find a PERL Cardiac emulator and original manual at: http://dale-miller.com/cardiac-cardboard-illustrative-aid-to-computation/ [2]. Or, you can purchase a cardboard version, with manual for $US 20 at: http://scientificsonline.com/ [3]. Scientifics has many other interesting products.

Budding electrical engineers might find digital logic fascinating, but I haven't found good books that combine knowledge of real ICs and experiments that exercise their functions. In 1978, David G. Larsen and Peter R. Rony wrote a two-book set, "Logic & Memory Experiments Using TTL ICs." These books are out of print, but you can find used copies at www.abebooks.com [4], starting at $US 5. The books include tutorial information, step-by-step experiments, and questions.

The experiments require basic 7400-series DIP ICs, LEDs, switches, and wire. Although the text recommends specific hardware--no longer available--a parent or colleague with electronics experience can create LED drivers from 7405 inverters and debounce switches or pushbuttons with 7400 NAND gates. Larsen and Rony used a 6V lantern battery with a diode in series to power a standard solderless breadboard. You can find everything you need at Jameco Electronics or Digikey.

Parallax recently introduced its PropScope, a PC-based digital-storage scope that offers two 10-bit-resolution analog channels that operate at 25 MSamples/sec over three voltage ranges. A USB cable supplies power from a laptop or bench PC. Each module comes with two x10 scope probes and an auxiliary card that provides an analog trigger, a 4-bit digital trigger, an 8-bit DAC and a 4-bit NTSC/PAL output. Software displays a traditional oscilloscope "panel," a function generator, a logic analyzer, a spectrum analyzer, and a vector-scope. Part number: 32220, price: $US 250. www.parallax.com [5]. This type of instrument didn't exist when I built simple transistor circuits and used an AC-coupled, 1-MHz bandwidth Heathkit IO-12 scope that would cost over $500 in today's dollars.

Kids should have their own tools, too. I recommend a plastic toolbox and to start, a basic screwdriver set, wire strippers, diagonal cutters, long-nose pliers, and a set of inexpensive nut drivers. Having one's own tools will instill a sense of pride in any young engineer or scientist. Just be sure to engrave the young person's name on each piece.

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