by Richard Mussler-Wright

2009 fischertechnik FAN CONVENTION

A gathering of the core of the "ft freak" community

The 2009 fischertechnik Fan Convention was hosted in gorgeous Erbes-Büdesheim, Germany. The convention was moved from Mörshausen to the home of Knobloch Electronic, the original producer of fischertechnik robotic controllers. This convention is the largest gathering of fischertechnik models and robots in the world.

fischertechnik ("ft" to fans and purposely spelled in the lower case) is a superb hobbyist manipulative made of hard nylon and utilizing a channel-and-groove fastening system. Hobbyists from around the world use ft to create a dazzling array of robots. According to Ralf Knobloch, more than 500 people visited the over 30 exhibitors in the 300-square-meter space. The event needed the space: "The tallest model at 7.35 meters tall was a crane built by Dirk Kutsch," said Mr. Knobloch.

Robots play an important role at the convention. Sven Engelke, an administrator of www.ftcommunity.de points to Jan Käberichs' checkers-playing ("Mühle") robot programmed in RoboPro and Joachim Jacobis' mobile robot that avoided obstacles while collecting tires as two of his favorite robots at the convention.
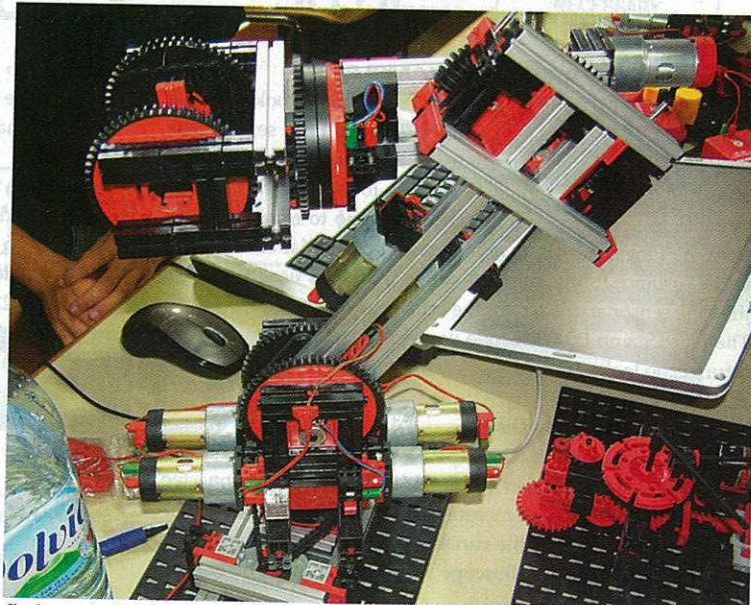
Several highlights of this year's convention were the new microcontrollers. Sven Engelke conducted a workshop on fischertechnik's new 32-bit processor controller, the TX. Henning

Jan Käberichs' checkers-playing ("Mühle") robot is programmed in RoboPro.
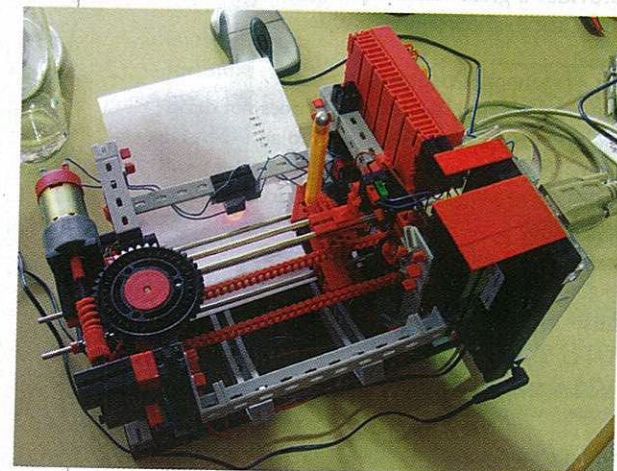
Homemade printer!

fischertechnik robot arm.

Above left: Frank Linde. Photo by Dieter Meckel. Right: fischertechnik ball robot.

Thomas Brestrich's RoboMax—the stair-climbing robot.

Leuz of LPE demonstrated a series of robots using the PCS Brain, which features four DC motor ports, eight sensor I/O ports, four servo ports and a variety of built-in connectors.

ROBOT INTERVIEWS A TOP FT FREAK

Frank Linde is a well-known "freak" (as ft fans are known) and robotic enthusiast. He shared his observations on this year's event:

Q: Please tell us about the history of the robots at the fischertechnik Community Convention. Has robotics always been a big theme at this event?

A: Yes, robots played a role right from the beginning. Since the Robo Interface was introduced by fischertechnik, we see a trend towards complex and mobile robots. Take the stationary robots for example: early designs showed three to four degrees of freedom. This year, one could admire several models with six degrees of freedom plus a tool function [gripper]. And we see more and more additional electronics like distance sensors, LCDs and high-resolution encoders.

Q: This year, the convention was in Erbes-Büdesheim. Can you describe the setting? Who was there? How many people attended?

A: Well, the community center is a combination of a sports hall and a tavern—imagine a small fair hall—and was well suited to the 33 exhibitors. In addition to the usual suspects from Germany, fans from Netherland, Austria and Switzerland attended the convention. Admission is free, and

One of the largest robot arms.
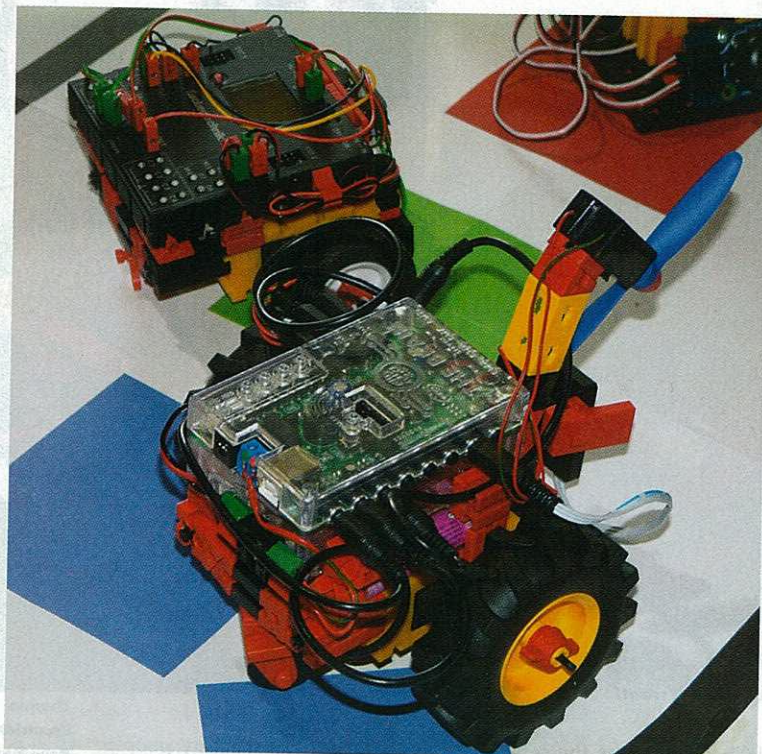
The PCS Brain and the new fischertechnik TX controller shown on a firefighting robot.

Stefan Falk, a leading ft enthusiast.

items could be called robots and about 10 items could be called CNC machines.

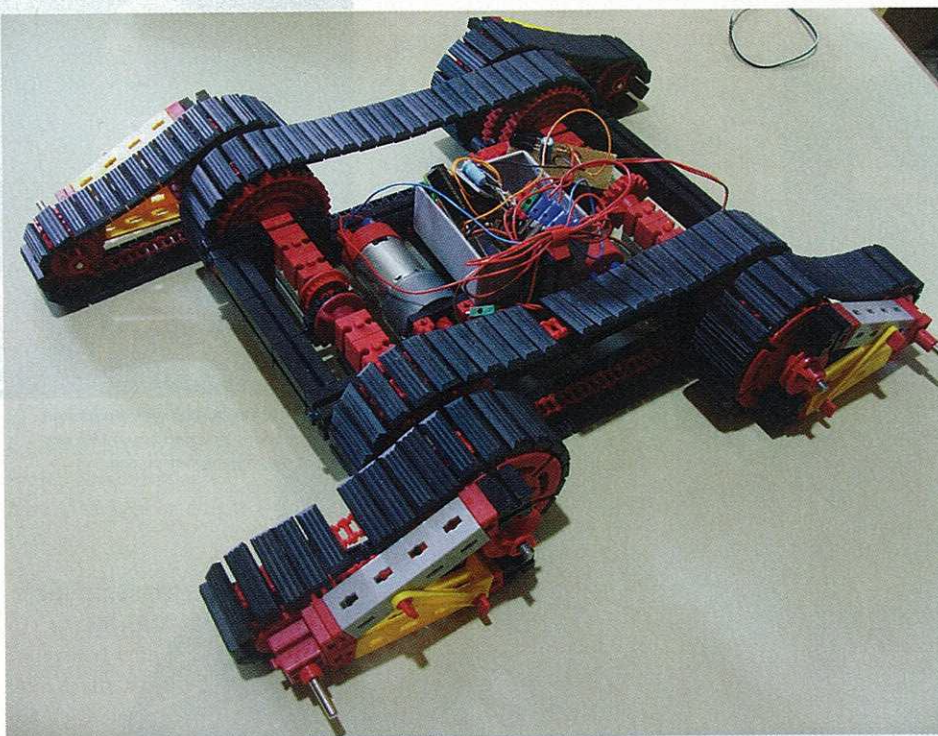**Q:** Can you describe some of the robots that were demonstrated?

A: The mobile robots included a line-follower, fire-fighter, cleaner, off-roader, manipulator, walker, stair-climber and a spherical ball robot. Examples of stationary robots included the checkers player, a palletizer, a six-axis arm, sorters, a hexapod, printer and 3D printers. But a picture is worth a thousand words, so I'd like to invite your readers to surf the convention picture pool at: www.ftcommunity.de/categories.php?cat_id=1721 to get a better impression of all the models.

Q: Which was your favorite robot and why?

A: I liked them all! It's amazing how many interesting details one can find even in the smallest models. And I was impressed by the sophisticated solutions that our young people presented. But yes, I had a favorite: Peter Damen demonstrated a ball robot built inside a Perspex sphere. Its physical form is far from conventional robot designs, and I was enthusiastic about its motion.

Q: What are the advantages of using fischertechnik in robot designs?

A: Rapid prototyping, reusable material, rapid prototyping, robust and solid constructions, rapid prototyping and no need of drilling, milling and screwing. By the way, did I mention rapid prototyping? Most robotic fans know from experience that simulation doesn't count because of too many variables; you need to build a physical model to check your ideas. With fischertechnik, you can change your physical robots

there were definitely more people than we usually had in Mörshausen!

Q: How many fischertechnik robots were there?

A: That depends on the definition of what makes a robot a robot, but to avoid endless discussions, I'd guess about 20

Joachim Jacobis' mobile robot avoided obstacles while collecting tires.

All-terrain mobile robot.

dimensions is intuitive and results in solid models, as the basic building blocks can have attachments made to all six sides.

Q: You have developed your own fischertechnik controller. Can you tell us about it?

A: The original fischertechnik controller, "Robo Interface," is a great product, but it's limited in some ways that prevent me from using it in most of my robots. My controller provides more current [5.6A peak], has a shorter cycle time [<1ms], features a serial bus to connect to other controllers and/or computers, is more compatible with standard sensors and LCDs [5V voltage, I²C bus] and can drive multiple servos and a stepper motor. The board size is just below 60 by 30 millimeters [2.36x1.18 inches], so it fits perfectly into the small fischertechnik battery box. Currently, I have a functional prototype that can be programmed in Assembler, BASIC, C, or PASCAL. A firmware to facilitate programming is still a work in progress, though.

as fast as if they were simulated in software and easily improve your designs as new ideas come to mind.

Q: Why does fischertechnik work so well to teach robotic applications?

A: fischertechnik concentrates on functional aspects and has been in the market for over 40 years. Thus, the system is nearly feature-complete without being bulky. Constructing in three

**Q:** How long have you been involved in the ft community event?

A: The fischertechnik Community Convention has been held since 2002 on an annual basis. I first attended in 2003 and made sure not to miss a single one since that year. It's marvelous to soak up the scent of the big, wide fischertechnik world!

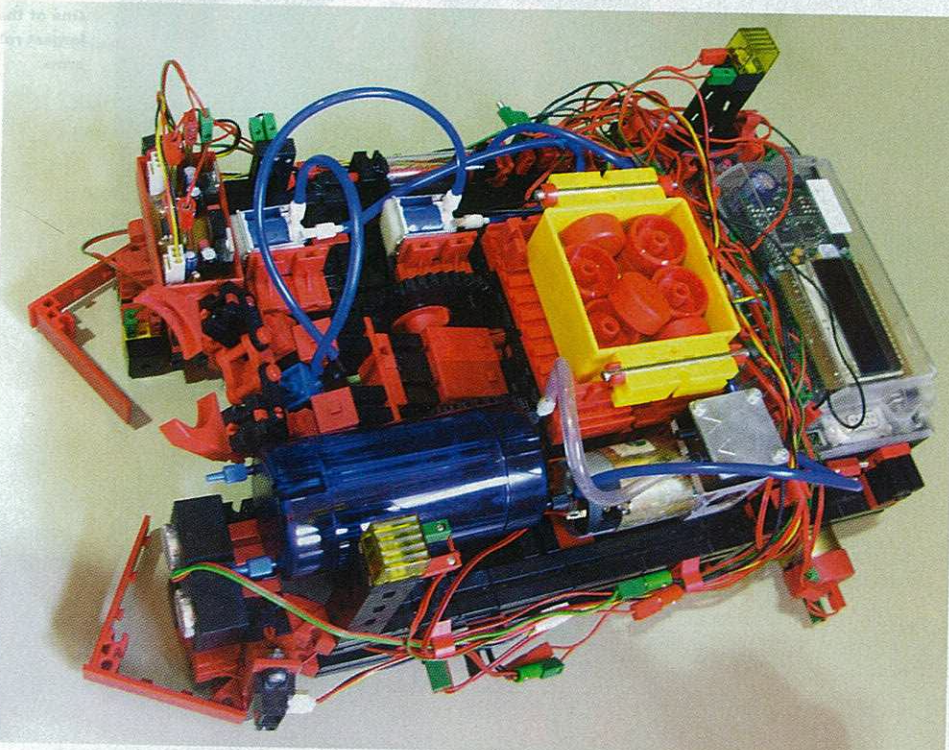*Richard Mussler-Wright is Director of Curriculum Development at PCS Edventures. —the editors* ◉

Links
fischertechnik robot gallery,
www.ftcommunity.de/
categories.php?cat_id=1721

PCS Edventures, http://edventures.com/imssc/nsimssc, (800) 429-3110
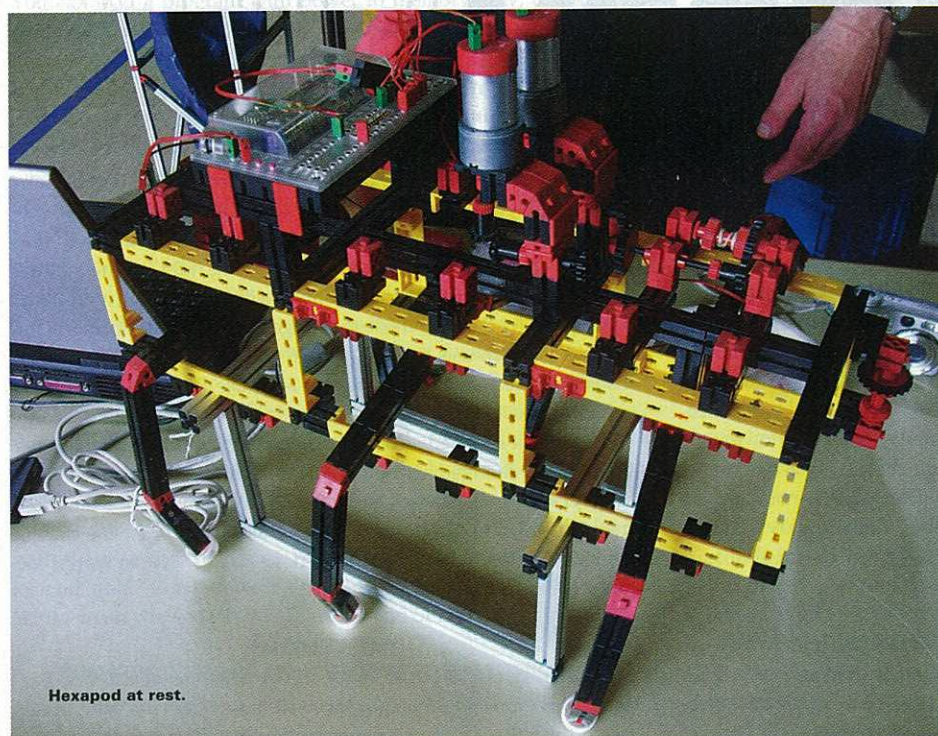
For more information, please see our source guide on page 89.

Hexapod at rest.

PCS Edventures Brain with fischertechnik Building Kit

by Tom Murphy

Easy programming combined with flexibility of design

Assembled Carousel project.
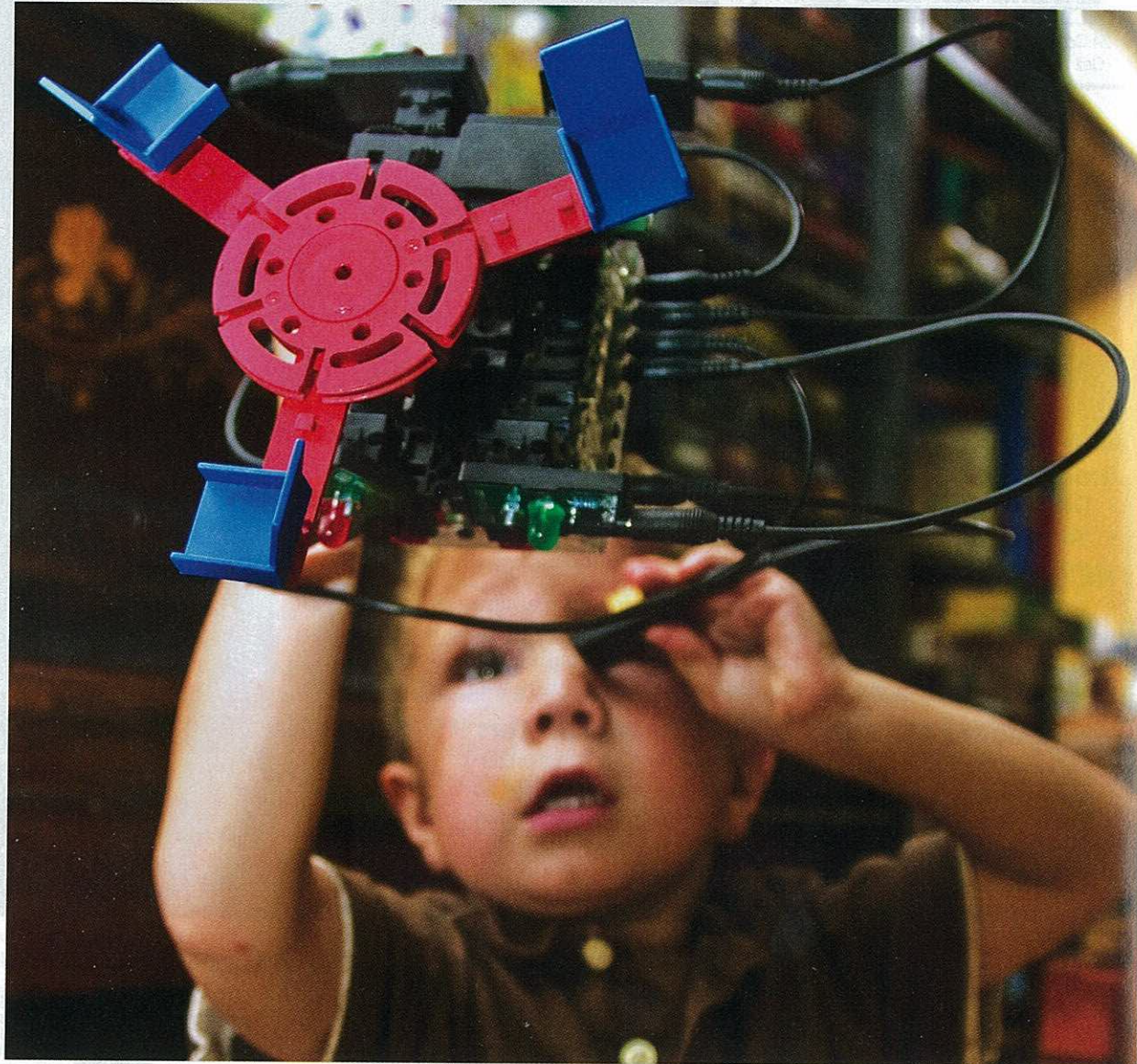
The essence of my review of the PCS Academy of Robotics Brain is very short. It is a great platform for an individual to learn robotics and for any school formalizing the study of robotics, especially with the PCS-sponsored competitions. There is an ideal balance between the constructive and programmatic aspects of robotics, while reducing the friction of learning a programming language. I highly recommend the Brain and its smooth integration with the fischertechnik building kit, which is an astounding marriage of ease of programming with flexibility of design.

I stress-tested the Brain by building Lesson 2, the Carousel, with my 4-year-old grandson, Declan. It was not designed for such a young a student, but supervised, Declan was a wonderful helper with the construction of the project. I will point out the lessons learned and places for improvement.
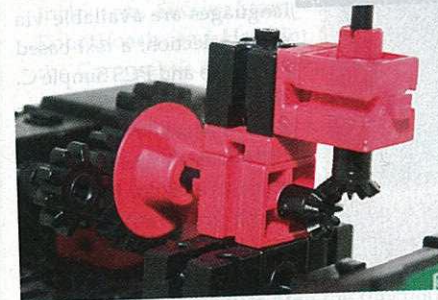
Documentation is the major area for improvement, but given the responsiveness of PCS in providing me info, it will likely be steadily updated for all users as the Brain matures and evolves. Every purchaser of this system wins.

PARALLELISM
As a professor of computer science, I am concerned with weaving parallelism into the computer science curriculum. Thus, my interest in parallel threads of execution with the Brain should be of no surprise. PCS hooked me up with some currently undocumented calls allowing me access to system timers. This will allow me to simulate three threads of execution.

They have graciously allowed our publishing of a version of my Carousel code on steroids; unfortunately, I have not yet successfully mapped a midi version of Wheezer's "Beverley Hills" to the PCS. It has to be "Beverly Hills," since my assistant, Declan, loves to sing it, and I am dying to witness the robot/human duo. The fault in witnessing this lies with my time and perfectionism. I want to successfully map the melody to the Brain's tone generator,
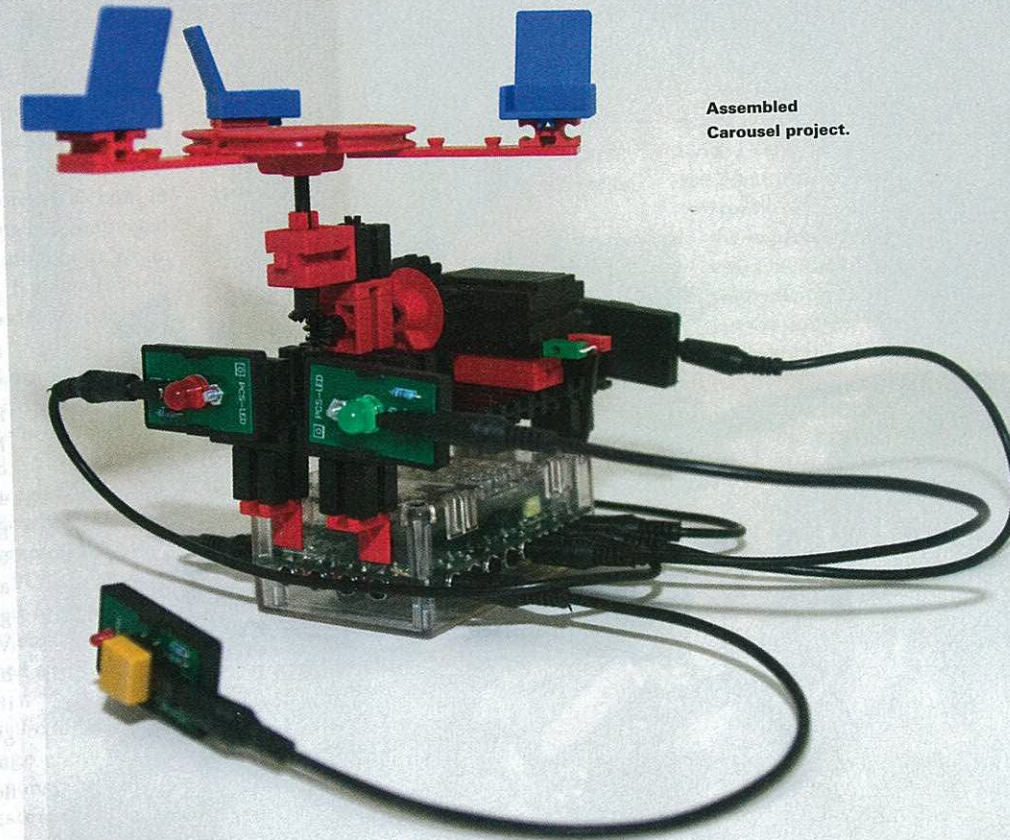

The fischertechnik kit comes with a variety of gear types that work well.

Edventures "robotics learning" products and curriculum are actively sold and used worldwide.] There is a place and time for jigsaw pieces put together in the only way they fit. Real problem-solving opportunities come when there are many ways things could fit together. It's a wonderful out-of-the-box experience, precursing the unfolding attention to detail and the sophistication of the entire kit.

a drum line to each of the red and green LEDs, and the cymbal hit to a flash of both red and green together. Stay tuned.

MECHANICS
You know you aren't in a highly scaffolded, one-way-to-build-it world, when the first thing you have to do is prepare the motor cables to attach a 9V motor of your choosing. A second indicator is in coursing the power through the cables from an AC adapter where you turn the dial to select a voltage between 6 and 12 volts DC. It also takes any AC from 110 to 220, so the next time I'm on a train to Ankara, I won't need a separate AC adapter. [Editor's note: PCS


PCS Brain components (left) and fischertechnik kit parts.

The Brain is a sturdy protected box with a lot of useful connection points. When I was running a high school robotics program, the students clamored for some form of BattleBot competition. To do so requires protection of the big investment, the CPU and its associated circuitry. We could have used the Brain. The Brain comes with four servo ports for connecting to motors; eight sensor and I/O ports for interacting and affecting the outside world; and there is a mysterious, undocumented USB port I look forward to playing with. It may be a way to introduce Bluetooth to the Brain, but this is a project for the future. There is a warning about the light sensor that only one port can safely be used. I recommend taping over the unused port; it was the first thing I did, since I hate sources of error. You will have to periodically move the tape depending on whether you want to trigger from going to bright light or from going to no light.

LEGO & FISCHERTECHNIK
The Brain is designed to connect with Legos, in the fashion of Lego MINDSTORMS. It is simultaneously also designed to connect with fischer-

PHOTOS BY TOM ATWOOD
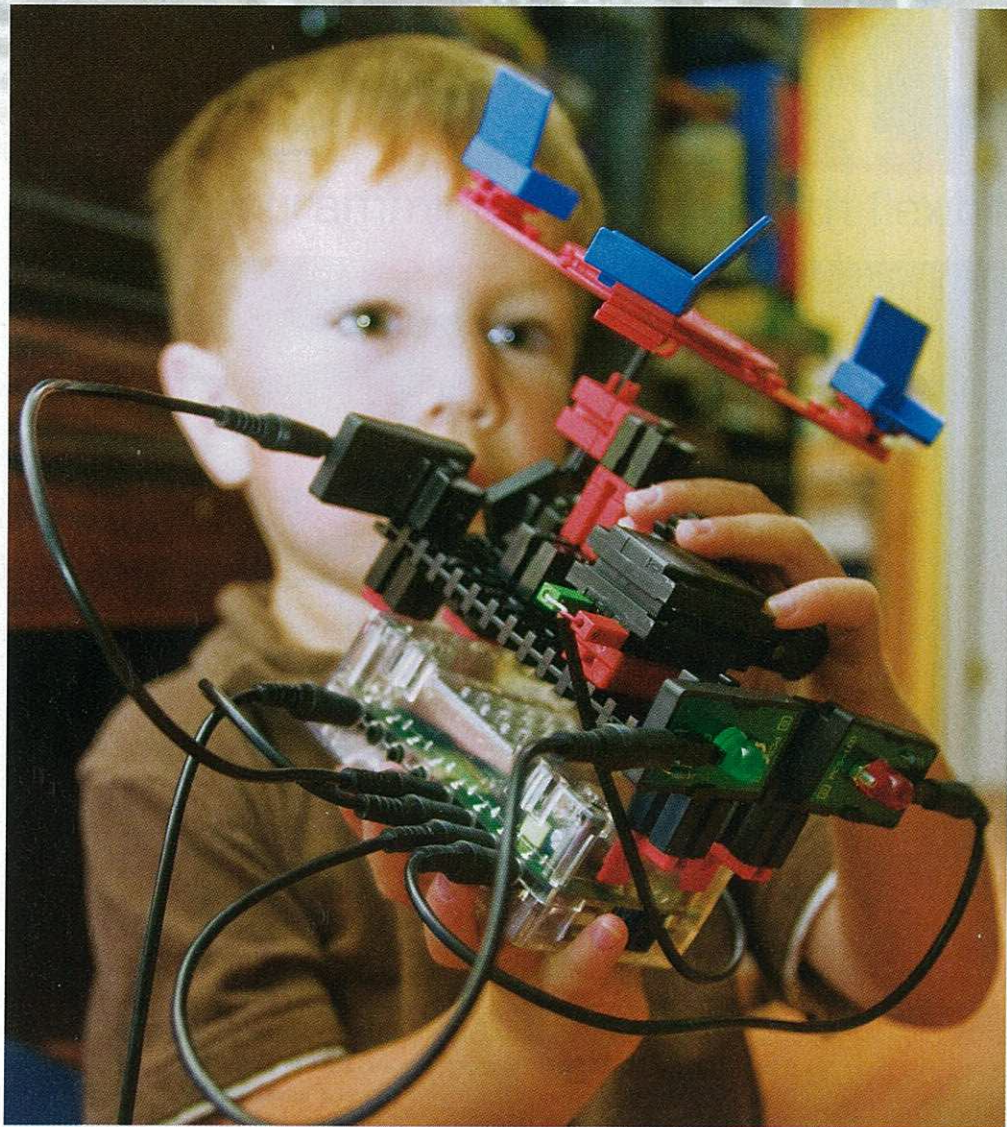
PROGRAMMING

One of the best aspects of the Brain is its programming flexibility. The PCS Brain has little barrier to first use, with the availability of well-planned-out projects and the ability to build in complexity from simple to more complex. First use is further fostered via the graphically accessible PCS Visual Logo with its drag-and-drop language components. Each programming element has clear jigsaw-piece interlocks, so you can see which programming components fit together. Experimentation is a key way to learn any programming language; PCS Visual Logo nicely fills the bill, helping students to intuitively accomplish their goals while acquiring familiarity with fundamental flow-of-control constructs.

Two additional related languages are available via menu selection: a text-based PCS Logo and PCS Simple C. This appeals to my CS professor's heart. When you are a proficient expert, the language C is like a piano keyboard from which many beautiful works are possible—as well as a discordant cacophony! As with the piano, there is a fairly steep learning curve before you can get to the point at which interesting things can be accomplished. Users can self-select to progress from the easy, simplistic graphical programming through a similar text-based version of the same language, allowing more complex programs, before steeling themselves for the powerful austerity of C.

I appreciate how the Rosetta Stone allowed Egyptian hieroglyphics to be understood. PCS has supplied a programmatic Rosetta Stone by providing the same five demo programs "If Else," "Procedures," "Repeat," "Run Motors," and "Send Sensor 0" presented in each of the three Cortex programming languages. I am quite impressed with the quality of the sample code. Every programming language relies on some form of the three different flow-of-control statements:

branching, looping and functions. Every robot program relies on two operations: manipulating sensors and manipulating actuators. The clarity of the sample code allows new users to hollow out the working code and substitute their own code. It is a very practical, time-honored way both to teach yourself programming as a motivated beginner, or to quickly retool code as an experienced practitioner. It is well worth any learner's time to periodically return to these five demo programs.

The Programming Language Equivalency Chart is delightful. It concisely shows the correspondence between fundamental programming building blocks among the three languages, which of course makes it another Rosetta Stone variant. As a hardcore programming geek, I would like to see a full PCS C reference manual, but this can wait for the future. The chart also shows Visual Logo commands I did not see defined elsewhere such as "Note" and "Beep."

There are also eight well-crafted projects that guide and challenge users to gain familiarity with robot construction and programming: Dragster, Carousel, Inchworm, Soccer, StomperBot, LineBot, RobotRoach, and HexaBot. Declan chose the Carousel as our grandfather/grandson project. After we had built it, we extended it with flashing lights and a switch so that we'd be able to change behaviors. The attached figures show the original Carousel PCS Visual Logo code as well as my extensions with Declan, which show how easy it is to extend a program. These projects are a great way to introduce both the function of parts and their application, which are two very different things. For instance, with a programming language, learning the function of a statement is essential, but far more meaningful is understanding the myriad ways a particular statement can be pressed into service.

THE DEVIL WAS IN THE DETAILS

What follows is a recitation of very small nits that gummed up progress in very small ways. As stated earlier, changed documentation will fix most all of them.

Our fischertechnik kit was apparently previously used and missing some pieces, thus increasing the challenge. A key omission was the plate attached to the Brain that allows its easy connection to fischertechnik parts. This required a bit of adaptation and improvisation. Luckily, there were lots of possibilities and even

some right ones that worked. It was something like "Apollo 13": the jury-rigged carbon-dioxide removal mailbox solution, without the drama and Tom Hanks.

The PCS website is useful but a little hard to use. I was looking for documentation of the Brain's programming language.
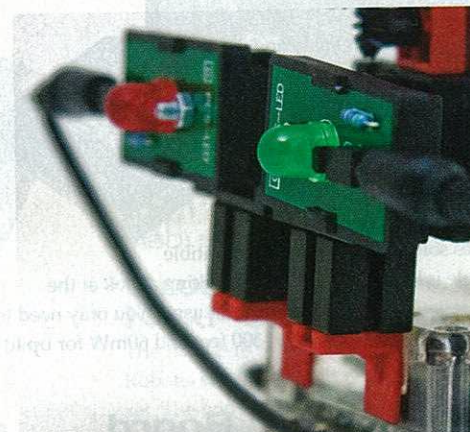
LEDs for timed lighting.
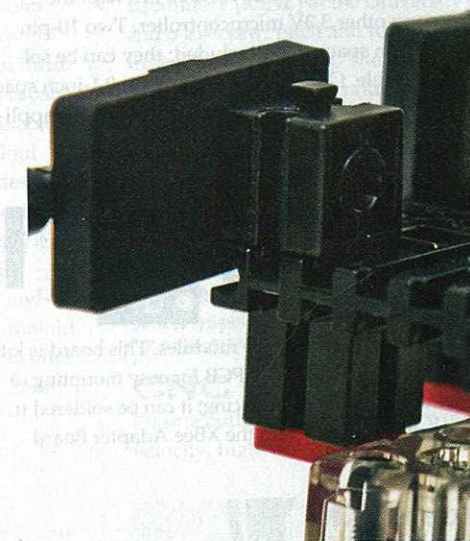
It took me a bit to realize I needed to look at the Cortex. The PCS User Guide says the Cortex will only work on a PC. I had little problem using VMware Fusion on my Mac to provide the successful illusion of its being a PC. The software downloaded with no extension. I merely had to manually add the .exe extension, which then allowed me to complete an easy installation.

The colors in the lessons differ from those shown when programming the Cortex, and this could be confusing. For instance, the blue Cortex flow-of-control icons are shown as green and purple in the lesson. The purple Cortex variable icons are shown in blue; the green Cortex sensor icon is also shown

in blue. But even with possible color confusion, it takes only a few extra moments to key in a very clear program.

One logistical problem is having programming icons too close to the right side, since I can't get down to the scroll bar to see them. An easy, but unsatisfying workaround was to add an extra icon to force the expansion of the programming canvas. One downside to this workaround was getting the icon stuck so that the cursor couldn't get off it. Saving and restoring the program took care of this.

RECOMMENDATIONS FOR THE FUTURE

The PCS website downloads page leads to marketing glossies; I'd prefer a support link that would lead to detailed documentation. I would love to have a Bluetooth capability as well as the ability to have a program running on my computer and interacting with the Brain, but these are far from essential requirements. They would just allow interesting effects.

I'd love to see variables supported by Visual PCS Logo, which would greatly extend the utility of the language.

I created some difficulties for myself by running the PC-only Cortex on my Mac. It was not clear how to do simple things like removing a segment, deleting a segment, or inserting a segment in Logo. My brilliant son BJ correctly reasoned that I could solve this by going to VMWare Fusion options and doing a send-key of Forward-Delete. It would be great to have documentation of all the expected valid keystrokes—even better if directly available from the Cortex help menu.

SUMMARY

The bottom line is that the PCS Brain is a brilliant educational device masquerading as a fun, engaging, engineering delight. It is well worth adding to your shortlist of opened-ended enrichments for a "bored" child (or adult). ◎

Links
PCS Edventures
http://edventures.com/imssc/nsimssc
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For more information, please see our source guide on page 89.

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technik parts. Boy, do I love these fischertechnik connectors! I had previously used other robotics kits with my students that had highly constrained and limited gearing possibilities. For the first time, I have sturdy, sophisticated parts with which to do open-ended design. I particularly enjoy the range of gearing possibilities—regular, bevel, cog and worm gears—with the pivot blocks, wheels, axles, pulleys and connection mechanisms to foster serious creativity.

Days could be spent just exploring the over 100 different kinds of parts, let alone the weeks exploring the implications of what can be built using them. To that end, an over 200-page fischertechnik catalog of projects with detailed, wordless assembly instructions is also included. Not only does this provide a boatload of challenge, but it also provides boatloads

of inspiration for the creation of detailed individual projects. By the way, don't worry too much about how these parts were jumbled because of the perils of "Guinness"—the rambunctious Catahoula hound living with Declan—since PCS has a comprehensive 1:1, to-scale parts picture sheet for familiarizing and sorting. It came in handy during our construction of the Carousel, which called for a 30mm clip axle, which isn't quite long enough to allow it to be connected with the required parts and doesn't include slots at the ends. The 45mm part comes with the necessary slots and worked just fine. Fischertechnik is great from a teaching perspective by supporting open-ended exploration. In this manner, I seek to infect my students to spend oodles of their own time seeking their self-defined success.