Mobile Studio

COMING SOON TO A DESKTOP

Near You

In 1999, Rensselaer professor Don Millard started thinking about a way to enable students to perform experiments anytime, anyplace—specifically experiments that use an oscilloscope, function generator, digital control, and some form of power supply. He started by looking at commercially available solutions, which were prohibitively expensive, and he wanted to involve students in bringing the project's vision to reality.

But it wasn't until Jason Coutermarsh, a grad student at Rensselaer, joined the project in the summer of 2004 that a complete functional prototype took shape. Today, thanks to a lot of hard work and the support of several technology companies, the Mobile Studio Project is a reality—and getting closer to commercialization.

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"Rensselaer's new Mobile Studio offers a cheaper and more effective way to provide studio instruction. At Howard University, instructors report that they are teaching more material in the same amount of time and see improvements in student attendance and performance using the Mobile Studio. Our students have requested broader use of the Mobile Studio with Tablet PCs, so we are looking to expand its use to the precollege programs, the freshman Introduction to Engineering Course as well as other courses within the College."

—James H. Johnson, Jr., Ph.D., P.E., DEE
Dean, College of Engineering, Architecture and Computer Sciences

Above: Rensselaer students currently enrolled in Professor Millard's class *Circuits*, (l to r) Michael Li, Brandt Gigle, Michele Viani, Dane Kouttron

Top Left: Professor Don Millard (left) and Jason Coutermarsh (right)

Bottom Left: Howard University students Abdou Diop and Abdoulaye Sy, debating over their circuit connection to the IOBoard. *photo courtesy of Howard University*

Bottom Right: Howard University student Shanell Haley drives the mouse pad of her Tablet PC to adjust the frequency of the sinusoid generated from the IOBoard. *photo courtesy of Howard University*

The Mobile Studio consists of an index-card-sized board that hooks up to a PC and turns the computer into a functional two-channel oscilloscope with full software manipulation and control capabilities. "So," Millard explains, "you can store waveforms you have acquired, recall them for further processing, and do manipulations that are offered by very expensive scopes but come for free, as it were, through integration with a PC. Students can also use the boards as general-purpose controllers in design projects, research studies, and artistic pursuits."

Affordability and mobility were the prime directives since day one, as Coutermarsh explains. "It was designed to be affordable for students. I can definitely see the board getting into K-12 schools. Having a $100 piece of hardware and a laptop that allows kids to do a whole range of electronic experiments would be something a lot of school districts would be interested in."

Designed for a New Generation of Engineers

Millard drew his inspiration for the Mobile Studio from a generation of engineering students that has virtually no tinkering background. "Their familiarity with using instruments and working with components is not as significant as previous generations," he says. "Instead of taking apart circuits and building things with erector sets as I did, they manipulate computer software. And the level of integration is so sophisticated in today's electronics that even if they did crack it open, it's not clear how much they would garner from it."

This becomes a drawback, he explains, when they get into an introductory electrical engineering course and can't visualize how the components work in the circuit, let alone in an entire system.

Now, with a simple, affordable circuit board and software, that obstacle can be overcome. "It's exciting to see students re-engaging in the classroom," Millard says. "It's really heartwarming the way their eyes light up when they see the results on the scope and watch how the waveforms change as they manipulate a potentiometer."

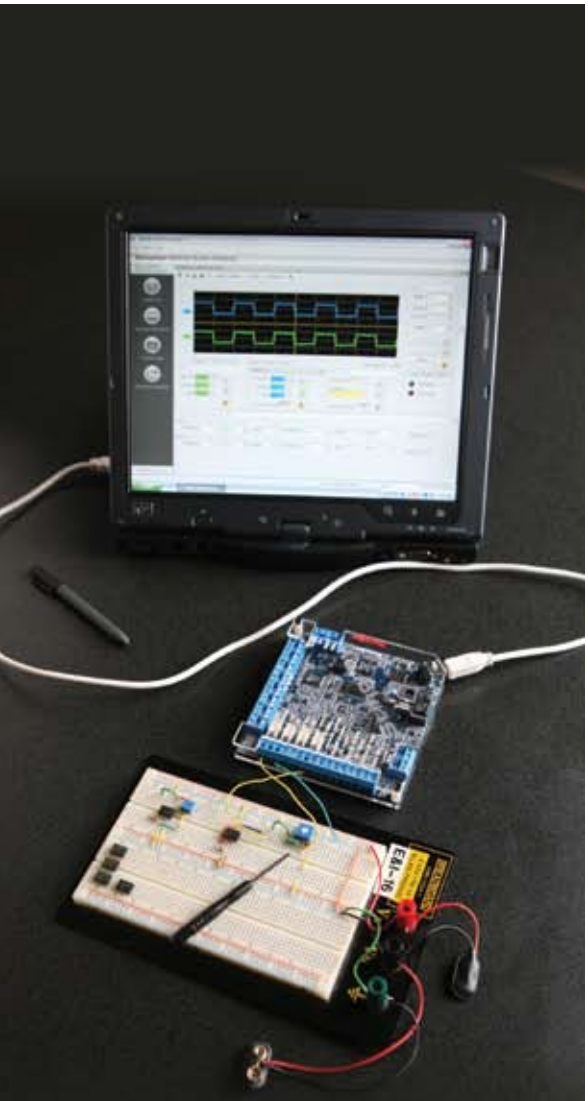
Bringing the Real World Into the Classroom…

According to Millard, "This changes the way faculty will engage and interact with students in the classroom. In one two-hour session, I can introduce the topic, have students do a paper-and-pencil type of problem, then put a cap on the knowledge with a real hardware experience, where they are actually able to build and test a circuit right at their desks. This allows us to scaffold the students' knowledge and offer multiple visualizations that aid the understanding of difficult concepts."

These experiments, in conjunction with the board, will resemble the type of experience students will encounter on the job. They also appear to help students do better on exams when given a design-oriented problem. "I believe that's because they have more of a gut intuition for what's going on, where to start, how to approach coming up with a solution," says Millard.

…and the Lab Out Into the Real World

Millard and Coutermarsh see the board as a way to extend the benefits of hands-on lab work globally—at a price point that will make it affordable even in developing countries. The Rensselaer team has already had inquiries from as far away as the Balkans, South Africa, and Australia. Which is not surprising, given the fact that for $100 or a little more, schools that can't afford to outfit labs with $10,000 worth of hardware can now offer this experience to their students.



Much like an iPod, the Mobile Studio board is a USB-based, plug-and-play peripheral that gets its power from the computer. Custom software, written by Coutermarsh, handles the setup and ensures it will integrate with other software. And with a processing power that dwarfs the iPod, it is actually less expensive.

To ensure that not just the device but the software and protocols will export seamlessly, Rensselaer is collaborating with Howard University and the Rose Hulman Institute of Technology in the beta testing process. According to Coutermarsh, "Howard is now using it to introduce labs earlier in the curriculum—they've been able to utilize the mobile studio pedagogy in sophomore courses."

Getting Ready for Prime Time

Although the difference between a working prototype and a commercial design can be enormous, the Rensselaer team had help along the way. Coutermarsh explains, "We showed the prototype to an RPI alumnus (who is a fellow at Analog Devices) and gave a presentation. He liked it and the company has supported us since then."

The first run of the "red board" version produced 200 units, followed by 200 of a newer "blue board," which allows students to observe, process, and generate signals on the order of several megahertz (MHz). This supports labs that study phenomena which only occur at these higher frequencies. "Now I'm sitting here with schools that have told me 'we want n number of boards, right away'—more than we can possibly make. Likewise, many students who have used the boards in the sophomore courses are now requesting them for use in their junior and senior design projects. So we've started discussions with companies such as National Instruments to commercialize it," Millard says.

"It's both exciting and daunting," Millard says. "Exciting, because every institution that sees the technology wants it. Daunting, because every institution that sees the technology wants a lot of it."

Jason Coutermarsh adds, "We are now considering a variety of future options. One option is to continue increasing the board's performance. But we may want to sacrifice performance a little bit to make it more reliable. The really high-performance stuff tends to be not quite as bulletproof. We are also exploring the use of wireless technologies to even further expand its application opportunities."

Whether the ultimate decision is to pursue blazing speed or bulletproofing, whether Rensselaer ultimately takes on full-scale production or partners with a commercial company, it's clear that the Mobile Studio Project is an idea whose time has come—and whose place is everywhere.

Note: Funding, hardware, and support for the project have been provided by:

- *National Science Foundation*
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