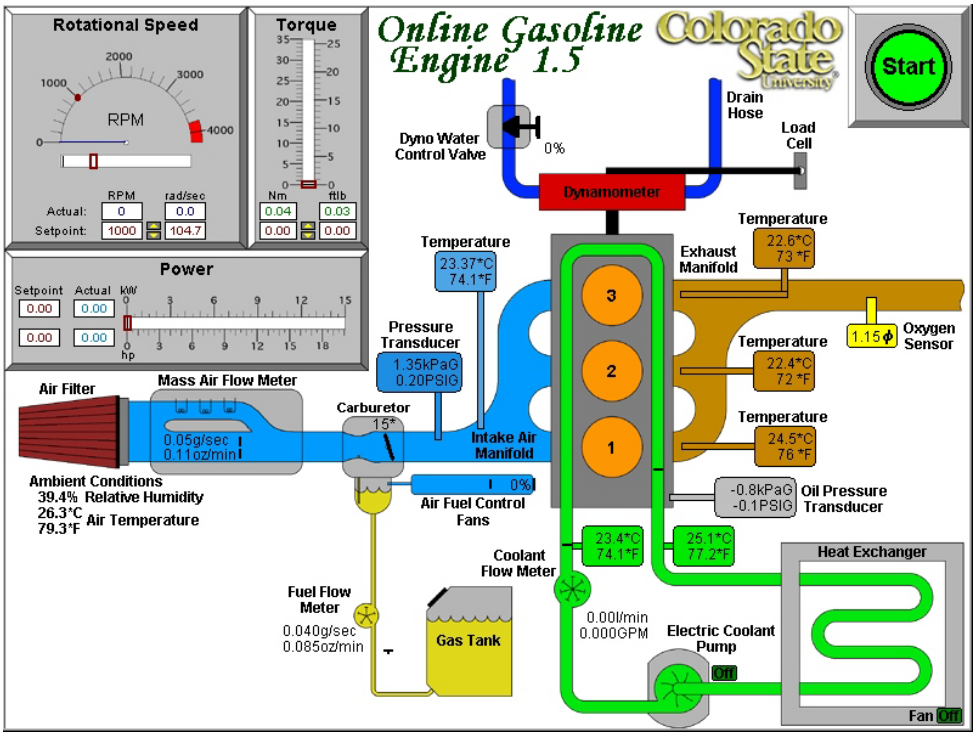
Colorado State and Opto 22 Put Engine Lab on the Net



College students and researchers all over the world are getting tired of simulations and virtual machines. Everybody, it seems, has one of those. Instead, students want to work with the real thing. So the Engines and Energy Conversion Laboratory (EECL) at Colorado State University in Fort Collins, CO, built a real engine test lab, and made it available for use by people worldwide over the Internet.

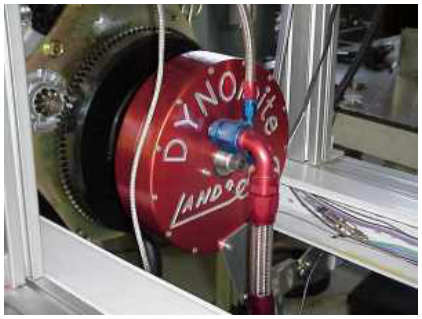
Online data acquisition equipment and engine controls for the Global Engine Project are supplied by Opto 22, and the Opto 22 controls have withstood the most severe test of all: they have survived abuse from graduate and undergraduate students for three years without a single failure.

Taking a Two-Stroke On Line

In the U.S., the number of universities with engine development programs and research labs is steadily decreasing because of the high cost of the specialized equipment involved. Simultaneously, the demand for people trained in engine testing and development is increasing rapidly. The increased demand comes from the transportation industry, of course, but also from the power industry because of its new focus on distributed power generation.

Based in the old Fort Collins Power Plant, the EECL is one of the most sophisticated university engine development labs in the world. It is probably best known for its Methanol Marathon competition, a contest sponsored by the U.S. Department of Energy to see which university can build the best methanol-fueled vehicle. It holds a similar competition for natural gas vehicles, and it conducts the annual "Great Ignition Shootout."

When it's not running competitions, the lab performs basic and advanced research on engines used in the natural gas industry, hybrid and large-bore engines, and two-cycle engines. It is researching high-pressure fuel gas injection, air pollutant formation, parametric



emission monitoring, process mixing within internal combustion engines, the effects of humidity on engine performance, and several other projects. The EECL gets all this work not only because it is one of the best labs in the world, but also because it is one of only a few available.

Dr. Bryan Willson, Associate Professor of Mechanical Engineering at Colorado State University and Director of the EECL, says they built the Global Engine Project to help meet the increasing demand for experienced researchers. "We decided to build an engine test facility that could be used by CSU students, and also by students all over the United States and around the world," says Willson.

Because of the high cost of building and maintaining such specialized research facilities, the Global Engine Project was commissioned by the National Science Foundation. The lab will allow students from grade school to Ph.D. level to dial up the facility, start up a 700-cc Briggs & Stratton Daihatsu two-stroke engine, run an engine test, and immediately download test data—all over the Internet.

Monitoring and control hardware from Opto 22 makes it possible for a student to change the load, speed, ignition timing, and air-fuel ratio online—and then monitor the fuel consumption, power and torque outputs, chemical energy consumed, work produced, and combustion efficiency. Studentscan also check heat balance to see where the heat is going. Sensors check exhaust, heat jacket, and water temperatures.

Withstanding Graduate Students

"All universities have Internet capability, but only a few actually use it for education," explains Willson." At most universities, professors post class notes and assignments, but it really doesn't go much farther than that. We wanted to figure out how to best use the Internet for education."

Willson says that some universities, including CSU, have built simulators for experimentation, but students want to control real hardware, not virtual machines. Therefore, CSU decided to build the real thing and make it robust and reliable enough to offer to the world over the Internet.

"We wanted to build this facility so we could learn the problems involved, see how students would view this method of testing, and find out all the interesting aspects of using the Internet for education," says Willson. " After students from all over the world use this, we expect to find out things about Internet education that we never even considered."

The need for reliability immediately eliminated the usual way of building collegiate hardware. "The normal way most universities develop data acquisition systems is to take a PC and stuff a general purpose analog/digital

Dr. Bryan Willson, Associate Professor of Mechanical Engineering at Colorado StateUniversity and Director of the EEC.

board in it," explains Willson. "Our experience is that we spend most of our time fighting problems with the boards and individual channels. If we do have a problem with one channel, we often lose the entire board—and then the entire test system goes down."

Willson used Opto 22 industrial I/O and controllers. "We have a lot of experience with Opto 22 because of the work we've done with large natural gas systems," says Willson. "Much of that gas equipment uses Opto 22 hardware because it is extremely reliable. Besides, even if an Opto 22 module did have a problem, we would only lose one channel of data, not an entire board."

The Global Engine Project runs under Opto 22 controllers. The user interface is generated using OptoDisplay software, and all the analog and digital I/O is wired into Opto 22 data acquisition systems. The control logic is written using Opto 22 programming.

"The Opto 22 hardware is tough," says Willson. "We've had three generations of graduate and undergraduate students through here, abusing it in all sorts of unforeseen ways, and we have had no equipment problems or failures whatsoever. If we had followed the normal university approach, my experience says we would have gone through many sets of boards by now."

Opto 22 solves another problem that often plagues universities. "Graduate students hate to write documentation," says Willson. "Every group of grad students works on the system, then makes changes to the controls, and they never document anything. Fortunately, the Opto 22 system is self-documenting."

The Global Test Engine has been available to the world for only a few weeks, so only a few hundred people have used it. One complaint so far: it's so easy to use, students think it's a simulation. "We had to add a microphone and sound so that testers would know they were working with a real engine, not a simulation," says Wilson.

To use the system, a tester goes onto the Web site, requests time for testing, and is given a test time and password. At the appointed time, he or she logs onto the site, enters the password, and receives a display that is identical to the screen on the Opto 22 controller.

The tester moves the mouse, enters data, and pushes buttons to adjust test parameters.

Clever programming fools the actual control system into thinking that the commands it is receiving are coming directly from the main console, not the Internet. "All we send the user is the screen display, and all we get back are mouse and keyboard movements," says Willson. "We did not want to require our users to obtain special software. It all works with any browser on any computer anywhere in the world."

So far, the lab has been accessed by students and researchers in the U.S., South America, Nepal, India, Korea, and Europe. It's being used by universities, high schools, and research labs. Next year, it will be available to junior high schools. Opto 22 is sure that its hardware will withstand the attentions even of junior high students.

About Opto 22

Opto 22 manufactures and develops hardware and software products for applications in industrial automation, remote monitoring, and enterprise data acquisition. Using standard, commercially available Internet, networking, and computer technologies, Opto 22's SNAP systems allow customers to monitor, control, and acquire data from all of the mechanical, electrical, or electronic assets that are key to their business operations. Opto 22's products and services support automation end users, OEMs, and information technology and operations personnel. Founded in 1974 and with over 85 million Opto 22-connected devices deployed worldwide, the company has an established reputation for quality and reliability. Opto 22 products are sold through a worldwide network of distributors, partners, and system integrators. For more information, contact Opto 22 headquarters at 800-321-OPTO or visit our Web site at www.opto22.com.

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