ENGINEERING

SPEL: The Signal Processing Educational Laboratory
University of Michigan

Assistant Professor of Electrical Engineering and Computer Science Gregory Wake®eld says that if he and his 12 University of Michigan student researchers had not used NeXT computers for a research project on acoustical and auditory signal processing, the project might never have gotten off the groundÐlet alone into the hands of researchers at Ford Motor Company.

ªIf we weren't using NeXT machines, we would have needed a support staff of software engineers and hackers,º explains Wake®eld. ªWe would never have been able to take the project this far on another platform.

ªInterface Builder, the App Kit, and Sound Kits were key,º he continues. ªThey allowed us to build flexible apps in an intuitive fashion. NeXT's multimedia props were also very important. In fact, that's why we purchased the machines in the ®rst place. We saw a lot of value in having video, audio, and text capability in one machine. The quality and availability of third-party software on the NeXT were also important factors to us.º

With NeXT technology, Wake®eld and students created a digital signal processing system that simulates how the human ear reacts in a variety of acoustical environments. Since 1989, Ford Motor Company has been integrating the research into the sound-quality evaluation and design of the company's future carsÐusing the DSP system to determine how the human ear responds to a particular power-train noise, for example.

ªWe've helped Ford close the loop on several auditory design questions,º says Wake®eld. ªThe project has had tremendous impact on the car designs we'll be seeing in the future.º

Back in the classroom, Wake®eld has developed customized software using NeXTSTEP to teach his seniors and ®rst-year graduate students about signal processing. Called Signal Processing Educational Laboratory (SPEL), the application is an exploratory tool used for signal analysis, design, and visualization. SPEL is organized around a set of applications that run within the SPEL environment. Each application is tracked by a SPEL manager that permits the user to transfer results from one application to another. For example, the user can edit the temporal representation of a signal, then play it, perform basic algebraic and transform operations on it, and then save it.

ªSPEL provides a very flexible way for students to explore sound,º says Wakefield. ªThey can see and hear signals, change and manipulate them, and then immediately view the outcome. With textbooks, students are only provided with a simple picture of signals. There's no opportunity for trying out alternative filter designs and seeing what happens.º

Wakefield further credits the flexibility of the NeXT environment for helping him get the SPEL project off the ground: ªThe most difficult thing about writing an educational application is creating a good user interface,º he says. ªIt takes a lot of revision. There's just no systematic way to do it the first timeÐand I didn't have a lot of time to spare. I had seen other windowing environments which were flexible, but took three pages of code to get the words `Hello, World' to pop up on screen. That's not a productive use of my time.

ªIn creating SPEL, we've really taken advantage of Interface Builder,º he says. ªWe can lay down the algorithms and just play them out on the screen, thereby experimenting with a number of alternatives. This isn't possible in other development environments.º

Wakefield says he originally attempted to create the SPEL application on an alternative UNIX workstation, but the project never got off the ground because of ªthe long development cycle involved in designing a student-proof application on that workstation.º

ªSPEL could have taken years to create,º he says, ªbut on a NeXT machine, the development cycle was two months. If I didn't have Interface Builder and the object kits, I would not have been able to create SPEL in the time I did.º

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