



Eye-tracking equipment results are monitored on computer display.

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The Eyes Have It

[By Coleen L. Geraghty](#)



Demonstration of eye-tracking equipment.

In the Gulf War and, again, in Operation Iraqi Freedom, technology has worked to the U.S. military's advantage, pinpointing the

location of strategic targets and enabling unmanned vehicles to fly deep into enemy territory.

Now, the Defense Advanced Research Projects Agency (DARPA), the research arm of the Department of Defense, is financing research into technology that would help military personnel make smarter decisions as they supervise command and control operations.

Scientists at San Diego State's Cognitive Ergonomics Research Facility (CERF) are involved in DARPA's \$30 million Augmented Cognition Program, which aims to increase the number of tasks an individual can accomplish.

The project is one of several augmented cognition ventures that received DARPA funds in the developmental stage, and is now ready to be tested for practical application by defense contractors.

SPAWAR's Jeffrey Morrison, a decision support project manager, said his agency represents the potential consumer of augmented cognition systems. "We'll take the gauges that work well and give them to defense contractors," Morrison said. "The major applications will be for training."

Project researchers started with a simple premise: create a system that allows its operator to accomplish a variety of complex tasks without being oppressively difficult to use. But now, the complicated part. As the operator becomes fatigued, or as one task becomes critical and demands his full attention, the system should recognize this, redirecting other assignments to improve the operator's performance while minimizing error. And one final demand of this technology – it should be able to detect when the operator is nearing overload, and reduce his workload accordingly.

Key to the system is a network of sensors that measures the operator's blood flow, eye movement, respiratory and heart rates and electrical brain activity as he works through a computer-based simulated military exercise. His tasks include navigating ships, monitoring airspace and determining ship status, which, performed simultaneously, require a combination of spatial, verbal and decision-making thought.

SDSU's partners in the DARPA project are Drexel University, SPAWAR and a number of private companies including AnthroTronix , Advanced Brain Monitoring, EyeTracking Inc., and Pacific Science and Engineering.

Dr. Sandra Marshall, SDSU psychology professor and director of CERF, has been intimately involved with the DARPA project from the beginning. Her development of the eye-tracking component of the sensory network has its roots in work she did for the Defense Department about 15 years ago. At the time, Marshall began monitoring the eye movements of Naval officers making tactical decisions. She built models of how the decisions were made by analyzing eye movement and pupil dilation.

Measuring short bursts of pupil dilation, Marshall found that they increased when a person was working hard, for example, solving complicated math problems or searching an Internet site. Her measurements also indicated when a subject was becoming tired, or when his task was too simple.

As she continued to develop the eye tracking technology, Marshall successfully obtained a patent with the help of the SDSU Foundation Technology Transfer Office. The patented technology then became the base for Marshall's Index of Cognitive Activity, which is owned by San Diego State and licensed for commercial use exclusively to EyeTracking, Inc., Marshall's private company of which she is president.

An attractive feature of Marshall's eye tracking equipment is its portability. It combines miniature sensing technology with hyperacuity image processing on a lightweight headband which contains three tiny cameras -- two to capture the gaze of each eye and another to measure head movements. EyeTracking researchers routinely take the instruments to remote locations, such as the Navy postgraduate school in Monterey, to assess how effectively officer trainees are using new computer displays.



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