OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Overview of the Electronic and Embedded Systems Group

EESG: Bridging Technology for World-Class Science

Purpose: Electronic and Embedded Systems Group provides world-class scientists at the Oak Ridge National Laboratory and other government agencies the tools they need to move forward in science and energy research.

Sponsors: Department of Energy and other government agencies.

Group Members:
- Dwight Clayton (Leader)
- Judy Potter (Admin. Support)
- Andy Andrews
- Alan Barker
- Mike Hileman
- Bill Holmes
- Don Hurst
- Bruce Jatko
- Roberto Lenarduzzi
- David McMillan
- John Munro
- Carl Sohns
- Bogdan Vacaliuc
- Christina Ward
- Ken Weaver
- Bobby Whitus
- Richard Willems
- Wes Wysor

Capabilities:
- Analog electronics.
- Digital electronics.
- Programmable logic.
- Low-power systems.
- User interfaces.
- Custom printed circuit boards.

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Electronic and Embedded Systems Group (EESG) uses modern electronic methods to bridge the gap between research scientists and solutions to nationally and internationally significant problems. This group specializes in the design of analog, digital, and mixed-signal electronics including complete supporting software from the device driver level to the user interface. Capabilities include printed circuit board design and layout, programmable logic devices, embedded microprocessors, low-power systems, and complete measurement system design and integration. EESG thrives on providing innovative electronic solutions to challenging real-world problems.

Capabilities

- Analog Electronics: Signal conditioning, low-noise high-gain amplifiers, power modules, high-voltage bias supplies, circumvention circuits, etc.
- Digital Electronics: High-speed logic designs, communication bus interfaces, "interfacing" logic, etc.
- Programmable devices: PALs, PLDs, FPGAs, UARTs and DSP cores for FPGAs, microprocessors, VHDL, etc.
- Low-Power Systems: Battery-operated handheld "smart" instruments (B10 Neutron detector, Hot Spotter, Portable Uranium Enrichment Meter, etc.).

Success Story: Block II Chemical Biological Mass Spectrometer

The Block II Chemical Biological Mass Spectrometer (CBMS) is the first integrated system capable of detecting and identifying both chemical and biological warfare agents. It was developed for the U.S. Army Soldier and Biological Chemical Command for missions such as reconnaissance, point detection, and stand-alone deployment. The development team was led by ORNL and included the coordination of five divisions and several outside agencies. CBMS won an R&D 100 Award in 2000 and is currently in production by Hamilton Sundstrand Sensor Systems. Other potential applications include counter-terrorism, civil defense, and health care.

The EESG led the electronics development for the CBMS. This radiation-hardened system was designed to withstand rugged battlefield vehicle conditions such as vibration and shock. Key electronics components include the following:

- Embedded Computer System—EESG modified first Pentium to pass radiation tests.
- Three Custom Compact PCI Circuit Boards—data acquisition and control, arbitrary waveform generation, and RF excitation generation and control.

- Low-Noise Analog Detection Electronics—delivers a new level of system sensitivity.
- Soldier Display Subsystem—compact embedded computer enclosure with removable smart media.
- QNX Operating System—EESG-developed device drivers and real time control and sequencing software.

Success Story: Hotspotter Nuclear Detector

The Hotspotter is an inexpensive portable device for detecting the presence of nuclear materials. EESG developed the required robust electronic circuitry for this compact system. It was designed to detect neutron- and gamma-emitting isotopes concealed in packages, vehicles, or on the human body. In addition, it offers the following features:

- Capability to differentiate medical isotopes.
- Capability to detect the presence of fissile material.
- Onboard multichannel analyzer.
- Library of spectra of selected radioisotopes.

Success Story: B10 Detector

The B10 Detector is a miniaturized neutron detector and counting system based on a Boron 10 diode. With a smaller footprint than a standard calculator, it contains the detector, an analog front end, and a low-power embedded microprocessor. Other features include the following:

- Low power for extended battery life.
- Nonvolatile onboard memory.
- Three operating modes.
- RS232 interface for uploading data to PC.

Success Story: Nuclear Material Identification System

The Nuclear Material Identification System (NMIS) was pioneered by ORNL and the Oak Ridge Y-12 Plant to sense the presence of fissile materials inside closed containers. Applications include nuclear materials control and accountability, process plant monitoring and control, nuclear criticality safety applications, nuclear warhead dismantlement, and nuclear arms control treaty verification. The system uses active and/or passive neutron and gamma interrogation to determine the characteristics of containers or devices containing fissile material. It also has the ability to perform active and passive gamma spectrometry. EESG recently developed data acquisition electronics for the NMIS system.

Some features of this system include the following:

- 5 analog input channels.
- Sustained 1.0 GHz sampling.
- Real-time data compression and formatting.
- Commercial off-the-shelf parts to reduce cost.
- Powered by PCI bus to improve portability.
- Field-upgradeable firmware for flexibility.

Contact Information

EESG looks forward to new challenges in adapting the latest in electronic technology to complex scientific measurements.

For more information about what EESG can do for you, please contact Dwight Clayton (claytonda@ornl.gov) at 865-576-8134.