Embedded World review
Nuernberg, Germany • February 22–24
Despite unusually large amounts of snowfall and the resulting traffic difficulties, about 11,000 visitors made their way to Nuernberg for this exhibition and conference.

Conference attendance increased by 25 percent and the number of exhibitors increased by 22 percent with more than one-third of the exhibitors coming from foreign countries (with most from the USA). About 480 companies exhibited their products in about 112,000 square feet of space in three exhibition halls. Each hall had a different focus (software, hardware, and tools).

Embedded World in Nuernberg was roughly the same size and had a similar number of attendees as Embedded Systems in San Francisco, USA. However, there were more exhibitors (especially international exhibitors) in Nuernberg.

Embedded awards and keynotes
The embedded Award 2005 was presented to one outstanding company/product in each of three categories:

- Contec (Austria) received their award for a very complex and extremely efficient phase control loop.
- aicas (Germany) was awarded for their real-time, Java-based software for aerospace and transportation applications.
- Lauterbach Datentechnik (Germany), known for their TRACE development tools, have developed a novel cache analyzer which can determine and fine-tune cache usage dynamically in memory constrained real time embedded systems.

Keynote addresses were held by internationally known experts from Texas Instruments, QNX, I-Logix, ENEA, and the Realtime Linux Foundation.

Experience Area Automotive
The conference included an Experience Area Automotive section, as automotive embedded electronics is an extremely important and booming market sector with double-digit growth rates in certain areas, such as Germany. Modern automobiles may include anywhere from 40 to 80 industrial-grade microprocessors in addition to several busses.

Most of the devices in these automotive applications are not normal commercial production devices due to harsh environmental and safety requirements. Companies like Infineon (Germany), ELMOS (Germany), Freescale (USA), and others produce automotive devices for these demanding applications. European automobile manufacturers are reducing the amount of gimmicks (unnecessary functions) and adding more and better quality safety and driving comfort functions.

One interesting function is available on BMW 7-series automobiles. As you drive by a parking spot on the side of the road, electronics measure the size of the spot to see if the car will fit into it for parking. The driver then just switches into reverse gear and the car automatically parks without any further assistance from the driver.

Infineon reported that about 33 percent of all worldwide automotive engine-control microprocessors are made by their company. Some of these microprocessors sell for less than one dollar in 10K quantities. They estimate that on average there are about 20 chips from Infineon in any new passenger car.

Data Resps has recently opened a subsidiary in Germany as a base in Europe’s largest embedded market (40 percent). Kenneth Ragnvaldsen, CEO of Data Resps, said they have set out “to become the leading ‘Embedded Solutions Company’ in Europe by the year 2010.” Data Resps have shown an impressive growth rate as their 2004 Nordic market operating revenues were over 34 percent higher than in 2003. Data Resps follows a concept of solutions (complete), services (analysis, planning, development, consulting), and products (COTS, embedded) to build recurring business in the embedded market segment.

Embedded human body system
Embedded systems are not always embedded in technical equipment. An artificial leg itself is technical, but it becomes an embedded body system when it is attached to the human body and operates in unison with the biological leg. The C-Leg (computerized leg) from Otto Bock Healthcare (Germany) is the world’s first completely microprocessor-controlled dynamic walking system with hydraulic swing and stance phase control (Figure 1).
The C-Leg embedded system was jointly developed over a seven-year time-period by the Austrian subsidiary and innovation center of Otto Bock Healthcare in Vienna, and by the medical research department of the Technical University in Berlin, Germany.

C-Leg operation
It functions like part of a humanoid robot as described in VMEbus Systems magazine (February 2005, pg. 18). However, the C-Leg, as an integral part of a human body, needs more elaborate dynamic control to walk in synchronism with the other leg and to offer smooth walking capabilities to avoid damage and fatigue for the rest of the body. The embedded system is based on scientific gait analysis and biomechanical studies. It automatically adapts stance stability on heel contact to avoid unintentional bending of the knee.

All this is performed under microprocessor and software control based on inputs from numerous sensors, by controlling electrical and hydraulic movement and damping systems dynamically in realtime. Otto Bock Healthcare has designed software that predicts the necessary force and resistance to move through different phases of the gait cycle, and it includes precautions against stumbling. It can be adjusted to the individual person’s weight and gait by temporal connection to a notebook computer to download individually fine-tuned bionic software routines.

In normal use, the sensors monitor the person’s movement 50 times per second, and automatically adjust for changes in terrain including changes for rough ground. In addition, knee stability when standing and various walking speeds are automated in the embedded control program. Since there are no artificial muscles, gravity and inertia are also used to facilitate walking as natural as possible.

C-Leg advantages
The C-Leg provides several benefits over purely mechanical knee systems. The amputee can ambulate at greater speeds with optimal biomechanically correct symmetry while expending less energy. Most importantly, they can walk safely step-over-step up and down stairs. The built-in battery lasts anywhere from 25 to 40 hours so it can support a full day’s activity. The recharge can be performed overnight or while traveling in a car via a cigarette lighter adapter.

The C-Leg was certified by the FDA for use by above-the-knee amputees after passing the world’s most severe tests. It is approved for persons weighing up to 125 kg (275 lbs). A number of insurance companies reimburse the cost of a C-Leg. The C-Leg comes with a 3-year worldwide mobility guarantee (with 2-year extension possible) and a free once-a-year check-up. A temporary service C-Leg is available free of charge if needed.

C-Leg users
During the first six years on the market, 7000 C-Legs were fitted worldwide with half of them fitted in the USA. For example:

- US Army SFC Michael McNaughton stepped on a land mine while stationed at Bagram Air Base in Afghanistan. He has returned to active military duty after a C-Leg prosthesis was fitted by the Walter Reed Medical Center in Washington, DC (Figure 2).

- Curtis Grimsley, a former basketball player and track-and-field athlete fitted with a C-Leg prosthesis, escaped the September 11, 2001 collapse of the World Trade Center towers by making his way down 70 stories from his office to safety in a nearby business building.

C-Leg is a registered trademark of the Otto Bock Healthcare in the United States and other countries. Other company product and service names may be the trademarks or service marks of others.

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