Engineering The Future

Michaelmas 2004

Cambridge University Engineering Society Magazine

C·U·E·S

Contents

CUES - 2004

CUES is one of the largest academic societies in Cambridge and is ever growing with over a 1000 members and many sponsors from various engineering areas.
Some of the main events for the year 2004...
The CUES **Annual dinner** was held at Robinson college with loads of food and plenty wine. The turn out was very good and it was a evening full of joy.
The CUES **Garden party** was held at Harvy Court during May week, which was also full of fun.
Michaelmas term has had few **visits**, including Cadbury world and Pilkington.
Some of the **presentations** organised this term were presented by GKN, BT, Rolls Royce and Exxon mobil.
The biggest even this term is the **CUES careers fair** which was on the 24th November at Guildhall, with many companies, including Shell, ARM, Airbus, GKN, Siemens & Rolls Royce taking part.
Our website www.cuesonline.org has been updated and is looking amazing!

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Low Power Design makes Solar Power Practical For Montreal Parking System

Isabelle Bettez
President & CEO
8D Technologies Inc.

Synopsis:

If you wanted to introduce a sophisticated embedded computer product to be used outdoors, you'd be hard-pressed to find tougher weather conditions for testing than in Montreal. The city has some of the most extreme weather changes in North America, and temperatures can change rapidly. Humidity can be high and winter nights are long and dark.

In 2002, the Society that manages street parking and public parking lots for the City of Montreal (Canada) wanted to replace thousands of older parking meters with more advanced technology. Société en commandite Stationnement de Montréal (SCSM) wanted to install smart payment terminals that would process various types of wireless secure e-payment – in Pay and Go mode * – as well as allowing the new terminals to be entirely powered by solar panels – without any connection to the power grid. Furthermore, SCSM wanted centralized access to payment and parking utilization data as well as reliable monitoring of the terminal's performance and security. Finally, SCSM was looking to provide immediate information to parking officers.

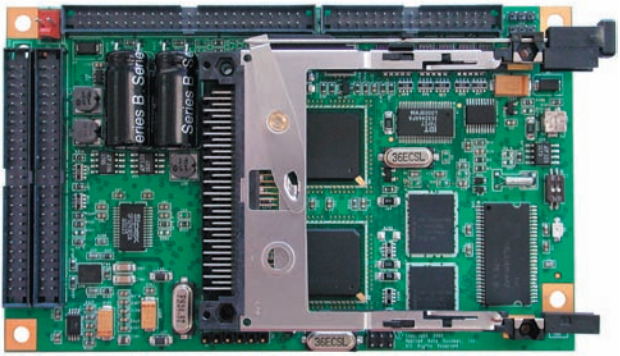
SCSM issued a call for tender in order to evaluate parking system design options that would meet its requirements.

8D Technologies, a software firm, used Applied Data Systems' ARM processor-based products to develop an application based on the world's leading 8D ECO platform.

Engineering Design Challenges

The application designers faced multiple challenges. The park

ing terminals had toensure totally secure wireless online electronic payment, while providing information on parking space utilization to a central system. Parking officers would drive by and view the payment status of all numbered spots on the street, displayed on their palmtop computer, without even getting out of their vehicle. If there were no infraction, they would drive to the next zone. Parking administrators would also need to access the server and get immediate information on all transactions as well as space utilization data on all different sectors. The system also had to monitor security and component performance within the terminal, sending warnings when something went wrong. With all these sophisticated functions, powerful computing resources were needed. One challenge was, how to power these computers off solar panels? What would be the lowest power consuming designs that could be used?



Montreal's weather was another challenge to the design. It has one of the harshest climates amongst the world's large cities. Temperatures can drop to – 30° C with heavy snowfalls in winter and reach above + 30° C in the midst of summer, with extreme humidity levels all year round. Temperatures can fluctuate by as much as 20 degrees C within 24 hours. Altogether, Montreal is a very demanding city for testing a sophisticated outdoor computer payment system! Finally, the overall system had to be easily programmable to reflect changes in parking rates and regulations or introduce new service models. As an example, the system could eventually be programmed to allow communication from an Internet connection.

This is where 8D turned to Applied Data Systems, design-

ers and manufacturers of ARM processor-based application-ready embedded systems.

Design Solutions

8D decided to proceed with a RISC-based platform, after realizing that another CPU technology was not powerful enough for this application. "Someone introduced us to ADS products, and we realized that ADS's Bitsy Plus was the ideal balance of CPU power, power management capabilities, form factor and capability to expand with additional boards," said Jean-Sebastien Bettez, CTO of 8D. "Further, ADS offered extensive support for Linux, which was quite important to us. At the point that we made our decision, we didn't find any other equivalent product to the Bitsy Plus."

For years, 8D had been developing complex wireless systems for the telecommunication, automotive and other industries. To increase efficiency in delivering advanced solutions, it had created Cloud9, a powerful Java-based operating environment that greatly simplifies system testing and reprogramming. The company had also introduced 8D ECO, a compact integrated unit that can be embedded in any remote device, providing advanced wireless communications and power management capacities.

By integrating 8D ECO on a companion card to the Applied Data Systems Bitsy Plus, 8D had the hardware platform they needed. Therefore, the project was simplified: a standard ARM-based system from ADS provided the extended environmental specs, computing power, extended IO and power management needed, already with full "Familiar Linux" support with all drivers in place and tested.

Starting with a power efficient ARM CPU, Applied Data builds complete single-board systems incorporating its ADSmartPower™ architecture. Sections of the board are selectively powered up as particular IO is used, and the system has a 'deep sleep' mode where is completely quiescent and I/O channels are monitored by a separate 8bit Micro CPU which draws only micro-amps.

With Cloud9 as the core software environment, 8D Technologies designed a complete application. Terminal compo-

nents were optimized in terms of power management and the 8D ECO boxes were integrated and programmed according to the client's requirements.

"We feel Linux is uniquely positioned to support a wide range of hardware components," said Isabelle Bettez, president and CEO of 8D. "Linux is powerful, stable, and extremely flexible."

8D Technologies also built the central server and all of the applications that manage the system and provide information to parking officers and their managers. The terminals' programming includes sophisticated energy management functions and reflects all parking regulations in terms of rates, duration, schedules, etc.

On a technical level, an independent industrial lab (CRIQ) tested the terminals in special chambers, submitting them to the most grueling weather simulations, including drastic temperature changes and extreme humidity.

"As the application went into production, we had great support from Applied Data Systems' Linux department," said Bettez. "We found the ADS distribution of Familiar Linux to be very complete and well integrated with power management."

A first series of terminals were successfully installed and utilized in 'Pay and Display' mode in public parking lots during the summer of 2003. Following this implementation, the definite testing period (the project's Phase II) began in fall 2003 with the extensive deployment of 'Pay and Go' terminals – and the attendant's PDAs – in the downtown core area. The system rapidly met client's expectations.

The Results – Finished Application Success!

The big winner with the 8D "Pay and Go" system is the customer. In the bone-chilling Montreal winters, the customer can go to a terminal, pay for parking in advance, with credit card or coin, and does not have to return to the car to place a ticket or marker, making the transaction more convenient and reducing time outdoors. The location of the car and its "paid-until" status is memorized by the system.

The officers charged with monitoring parking also benefit with 8D technology. They have the option to stay in their car and

still check a car's paid status. Not having to exit the car adds to the overall efficiency with the "Pay & Go" concept, as the user doesn't have to display the ticket in the car, and the parking officer doesn't have to stop at each vehicle on the street to read the ticket to see if time is up, or remove snow when needed. With the Pay & Go concept, officers don't need to leave their vehicle since all the information is on the PDA real-time, because of the new 8D technology.

The integration of the 8D ECO technology has enabled the creation of what is certainly one of the most advanced wireless point-of-sale payment systems in the world. And, thanks to the module's exceptional power management capacities derived from an ARM processor-based architecture, the terminals could literally operate in the middle of nowhere! The BitsyPlus™ units even include smart programs to charge and maintain batteries off the Solar cells to keep the terminal active through the long Montréal night. The technology's flexibility also enabled the terminal's supplier to rapidly address the customer's changing requirements. In designing any system with that level of innovation, adjustments in the course of the project are to be expected and 8D ECO has proven to be the perfect tool to do this.

Furthermore, the system will remain totally upgradeable and flexible for as long as it is in use. Since the 8D ECO technology is easily programmable, the city can now rapidly develop new capacities with very little investment. Efficient at all levels, the 8D ECO-powered solution is already attracting attention from large cities in several countries. It is also opening new horizons, not only for parking administrators, but for a wide variety of companies that manage distributed point of sale systems.

CUES Annual Dinner 2004

CUES Garden Party 2004

"Torque Technology Boosts Vehicle Performance"

Dan Ninan from GKN provides an insight into state-of-the-art driveline technology

Winter testing tracks are the automotive industry's proving ground for advanced powertrain and driveline components, especially those designed to improve the vehicle's traction and stability in extremely cold conditions. Test vehicles, bristling with data logging equipment, are driven through a tough regime of twists, turns, climbs and descents on a variety of surfaces to fully test, characterise and optimise their performance envelope.

GKN Driveline has developed ETM (Electronic Torque Manager) on winter test tracks in Michigan, USA and Arjeplog, Sweden. The product has been launched on the VW Touareg and Porsche Cayenne with a new application on the Land Rover Discovery this year.

ETM provides active electronic control to a differential which manages the distribution of engine power between the wheels. The design of such a complex system brings together mechanical and electronic elements with a software control module that takes its inputs from the vehicle's CAN bus – the central nervous system of all modern vehicles.

Data such as throttle position, steering angle, yaw speed, wheel speed, and anti-lock brake system, (ABS), data are fed through algorithms to provide the output signals that trigger the optimal flow of engine power to the wheels.

A classic demonstration of ETM's capabilities is the split-μ gradient: a hill start test where one side of the vehicle is on ice and the other side on tarmac. Even a vehicle with an ABS based traction control system could experience some wheel slip in these conditions and a delay before it can accelerate up

input.

The ETM also provides performance benefits when driving on motorways and roads. Emergency lane changing in slippery conditions becomes more controlled with the ETM working in conjunction with the Anti-Lock Braking (ABS) and Electronic Stability Programme (ESP).

The ETM works by providing continuously variable control by using an electric motor to engage a clutch pack (via a ball ramp mechanism) to lock the differential.

Its major benefit is very fast (short) application and release time which permits that ETM is compatible with Dynamic Stability Control (DSC) systems.

Land Rover has chosen GKN Driveline's ETM to control torque distribution of the rear final drive unit of the new Discovery. It is fitted to all air suspension Discoveries as standard and is a key component of Land Rover's revolutionary Terrain Response system: five driver-selected programmes which provide optimised performance in various on- and off-road driving conditions.

Advanced Torque Technology products like the ETM promise to be a big growth area for GKN Driveline which is already market leader in Constant Velocity Joint (CVJ) sideshafts.

GKN Driveline is the biggest division of GKN plc and has its own website with all the latest product news: www.gkndriveline.com

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Waves of change

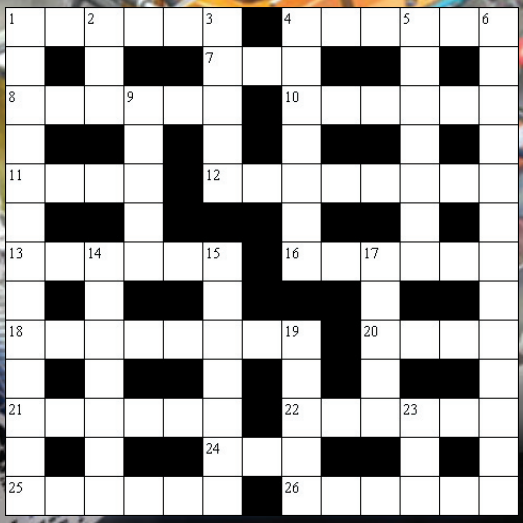
Crosswords

Clues Across:

1. Forbid girl from eating fruit.
4. Looked after Edward's intellect?
7. Greek invention, shear genius for the time!
8. Using tennis terms from the start.
10. The holidays, short affairs in Africa, were rather wild.
11. The sound of confusion after every night.
12. My encore was a formality.
13. Failure, again caused by negligence.
16. Rotten dermatitis, very sore!
18. A lie must recreate.
20. Decorated a cake, and then froze it?
21. Heaven - you reach the peak before Ian!
22. The decaying machinery I see is unsophisticated, yet idyllic.
24. Trapped by a bulk of information.
25. Repetitive chortling, lots of it.
26. Pester and irritate as a rash would.

Clues Down:

1. Stress from a medical exam and family ties.
2. That isn't very well tied.
3. Correct symbol held aloft.
4. Smells like a rodent.
5. The most beautiful geometric construction?
6. The results of a milkmaid's poorly written journal.
9. Susan cut short a greeting to enjoy a suspicious lunch.
14. The enormous, hairy mother of all insects
15. Embarrassed mystics?
17. Always being hit on the head, yet he succeeds.
19. It has an element of home about it.
23. A letter can be comforting, but even better over a chat.



Prize: A bottle of wine!
Please send answers to Chris Field, Gonville and Caius College.