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22 October 2013

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The real face of robotics

Meet Zeno - the lifelike robot designed to make STEM education interesting and to help autistic children communicate



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Empathising with the autistic

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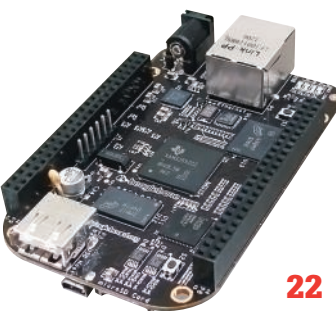
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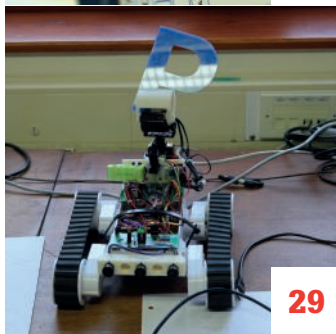
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The Electronics Design Show's first outing is a success, with more than 1000 visitors

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Plus the most popular blogs and videos from the *New Electronics* website

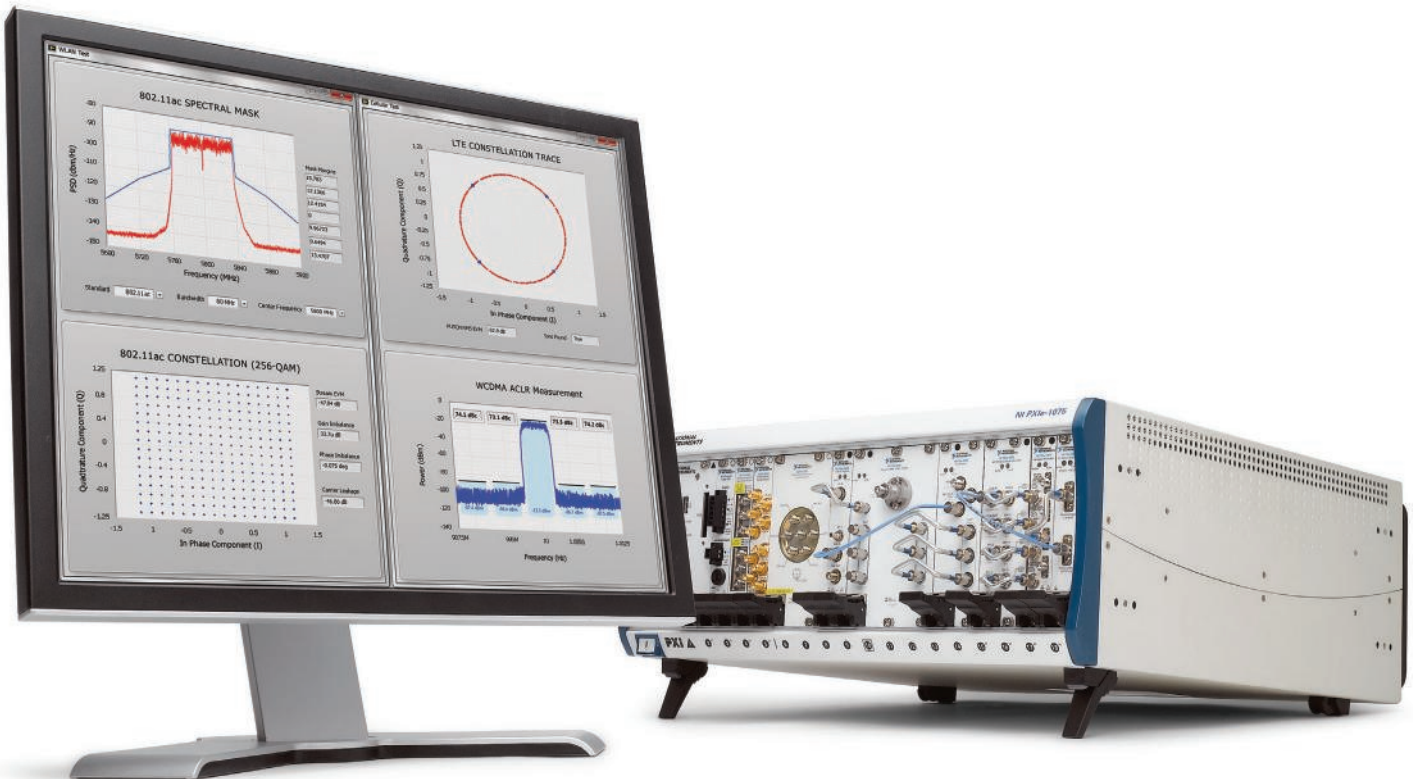
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Closing the gap

Business and academia disagree on how to boost STEM student numbers.



It's not exactly news, but the findings from a survey conducted by MathWorks into the STEM (science, technology, engineering and maths) skills gap shows there's still a lot of work left to do.

According to the results, 60% of employers and 80% of universities surveyed believe there aren't enough skilled candidates leaving education to meet industry's needs. The findings reinforce previous studies and the widely held belief that too few school students are being encouraged – either by their schools or by their negative perceptions of remuneration and opportunities – to pursue STEM subjects at university.

We've known for some time about the gap and the efforts of various governments and organisations have, in general, failed to turn the tide. At an industry event earlier this year, an academic quoted some telling statistics. If you assume that engineering sector vacancies will grow at 2.4% a year and factor in the number of engineers retiring, universities need to double the number of graduates being produced. That's not going to happen overnight, something employers and academics recognise and believe will take a decade to overcome.

While employers and academics agree there's a problem, they disagree about the solution. Employers think they should have a bigger say in the STEM curriculum; 54% of academics disagree. More than 60% of businesses want to see more project based learning; only 34% of academics agree. And more than half of employers believe students won't reach their potential without project based learning (see Design+ on page 29 to see how Reading University is tackling this).

A number of reasons for the decline in engineering undergraduates have been put forward over the years, including 'engineering is too hard', 'it doesn't pay well' and 'there aren't any prospects'. Employers and academics arguing about the curriculum is part of the solution, but the decline will not be reversed until school students see good reasons to want to become engineers.

As *New Electronics* said in its 8 October issue, there is a lot of young talent out there – male and female alike – and we as an industry are doing little to spark the initial interest and then nurture it.

Graham Pitcher, Group Editor (gpitcher@findlay.co.uk)



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Graphene Flagship launched

EC INVESTING €1BN TO COMMERCIALISE RESEARCH.
LAURA HOPPERTON REPORTS.

The European Commission (EC) has launched its 10 year €1billion Graphene Flagship, an initiative it hopes will take the technology out of the research lab and into the real world. The hope is that the Flagship will revolutionise multiple industries and create economic growth and new jobs in Europe.

"There will be challenges; let's be clear about that," said Carl-Christian Buhr, a member of EC vice president Neelie Kroes' cabinet. "One challenge will be to keep the agility, to get the right new partners inside, so that you can react and steer in a new direction as the context changes. Another is, of course, the scientific challenge. Thirdly, we need to bring in industry in such a way that ideas are taken up and lead to new products and markets. That's the whole idea of the flagship."

The Graphene Flagship, which is being coordinated from Gothenburg by Chalmers University of Technology, will be divided into two separate phases: a 30 month ramp up phase with funding of €54m from the EC, and a steady state phase starting in 2016, with EC funding expected to be €50m per year.

The consortium will initially include 75 academic and industrial partners in 17 European countries. It will then be expanded with another 20 to 30 groups through an open call, to be issued in November 2013.

Ford unveils 'crash proof' car

Fully Assisted Parking Aid and Obstacle Avoidance prototype technologies have been showcased at Ford's test facilities in Belgium.

The crash avoidance technology, developed as part of a European funded research project led by Ford, uses automatic steering and braking to avoid collisions with vehicles and pedestrians.

The test vehicle issues a warning first if it detects slow moving objects, stationary obstacles or pedestrians in the same lane ahead. If the driver fails to steer or brake following those warnings, the system will then automatically steer and brake to avoid a collision.

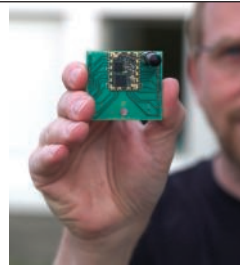
Meanwhile, the parking aid enables drivers to park 'at the touch of a button' from inside or outside the car, with steering, gear selection and forward and reverse motion controlled automatically.

The next step, says Ford, is to make both technologies available on production vehicles.

IBM, Semtech address IoT sensors

Looking to take advantage of opportunities unfolding from Internet of Things applications, IBM and Semtech have combined their software and hardware respectively to create a system capable of transmitting data over distances of up to 15km. The improvement is enabled by Semtech's LoRa modulation technology.

IBM has launched a software development kit – called Mote Runner – which runs on Semtech's SX1272 rf chip. The SX127x will be used for end nodes, while the SX130x will be applied in gateways and both have power consumption low enough to run from batteries. By adopting an adaptive link rate, battery lifetime is maximised and the capacity of the network is improved. Network robustness is also boosted, say the partners.



Giant sized tablet

Zytronic's projected capacitive technology is being used in a giant digital signage unit being deployed across Europe. The 72in touch enabled display units, manufactured by Surtronic, act like supersized tablets. Users can 'swipe', 'flick' and 'pinch' to get directions to shops and other amenities in the vicinity. They can also upload content via a built in camera.

The UK firm's Zybrid touch sensors use copper capacitors measuring 10µm in diameter. The technology is unaffected by liquid, dust and dirt and will work with gloved hands.

Surtronic is planning to install the units, which feature an 8mm thick tempered glass overlay to protect against vandalism, in retail areas across Europe, as well as in transportation hubs, where they will provide interactive travel information.

BRIEFS

Good times for low jitter

A number of features in its latest products will give IDT back its technological leadership in timing devices, according to the company's director of system architecture, Ian Dobson. "Historically, the performance bottlenecks have been around cpus and memories but, over the past few years, we have seen those bottlenecks move to the interfaces, the connectivity between the systems – and that is where we have been focusing our activity."

The result of this activity is the third generation of its Universal Frequency Translator family of timing devices for high performance optical networks, wireless base stations and 100Gbit Ethernet interface applications. The devices can generate eight output frequencies, two of which use fractional dividers to provide unrelated frequencies.

The device can accept up to four inputs, which can be from a low cost crystal resonator, and a notable achievement is the 300fs rms phase jitter over the standard 12kHz to 20MHz integration range.

Powering the programmable future

Five months after the acquisition of Enpirion, Altera is announcing the first implementation of its technology in the shape of power optimised reference designs based on the Cyclone V SoC.

Mark Davidson, marketing director of Altera's power business unit, said: "Every fpga requires power and the first thing we are doing is power optimised reference designs. It has allowed us to do some optimisation that we couldn't do before. Enpirion has some core technologies that are state of the art. Customers don't want to spend time on the power supply. The power supply adds nothing but, potentially, can take a lot away. We are helping customers spend more time on the fpga and speed time to market."

Reference designs for Stratix, Arria and Cyclone families will follow.

Context awareness enabled

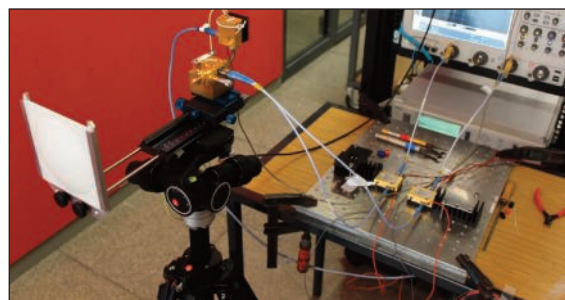
SMALL SCALE FPGAS TO ANSWER 'WHERE', 'WHAT' AND 'WHEN'.
GRAHAM PITCHER REPORTS.

Looking to enable context awareness in devices such as smartphones, Lattice has extended its iCE40 fpga family with the addition of what it says are the most flexible single chip sensor solutions yet launched.

Ted Marena, director of solutions marketing, said developers have been trying to solve the context awareness problem for a while. "They are looking to provide what, where, when style information, but the problem is the device needs to be always on to monitor sensors continually." Marena also pointed to power consumption issues. "If you can overcome these, there are lots of new products that can be implemented."

Two parts have been announced: the ice40LM and the 40LP. The LM variant is intended for use as a sensor management device, with hard IP for strobe generators, i²c and spi interfaces. Lattice says the part reduces power consumption by a factor of 100, compared with application processor based approaches. The LP variant is described as an IR subsystem, offering IR remote, bar code emulation and led driver features.

LM parts, which will be available with 1000, 2000 and 4000 look up tables, are said to consume less than 1mW in active mode. The parts will come in a 1.71 x 1.71mm package. The LP range will be supplied in a 16ball wafer level chip scale package measuring 1.4 x 1.48mm, with a choice of 640 and 1000 LUTs.



Wireless data transmitted at 100Gbit/s using 237.5GHz carrier

Researchers at the Karlsruhe Institute of Technology have transmitted data at 100Gbit/s over a distance of 20m using a carrier frequency of 237.5GHz; an achievement for which they are claiming a world record.

In the experiment, radio signals were generated optically, with several bits combined using data symbols and transmitted at the same time. The transmitter generates the signals using an ultra broadband photon mixer, in which two optical laser signals of different frequencies are superimposed on a photodiode. The electrical signal was then radiated via an antenna. Data was received using active integrated electronic circuits produced by the Fraunhofer Institute of Applied Solid State Physics.

Three steps to Zero appeal

Silicon Labs has launched Zero Gecko, an 'energy friendly' 32bit mcu, with features such as reduced processing time and a wake up time of 2µs contributing to ultra low power consumption.

Being part of a family has added benefits, as Dan Cooley, director of marketing at Silicon Labs, explained: "People have designed with the Tiny Gecko but, because they are pin compatible devices, they can use Zero Gecko for production."

Spice up your simulation

Cadence has launched the Spectre XPS, a FastSPICE simulator that enables more comprehensive simulation of complex chips.

Features such as the impact of IR drop, suit it to low power mobile designs. It also allows reuse of models, stimulus, analysis and overall methodology, reducing support costs while improving time to production.

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Show beats attendance target

FIRST OUTING FOR ELECTRONICS DESIGN SHOW IS A SUCCESS. GRAHAM PITCHER REPORTS.

When Findlay Media announced last year that it was tripling the size of the Engineering Design Show in 2013 by launching the Electronics Design Show and Engineering Materials Live, there was a deal of scepticism about whether a newly launched event could be grown that quickly.

While 2012's event occupied one hall at Coventry's Ricoh Arena – with a floor space of 2000m² and 80 stands – this year's event took up 6000m², hosting more than 170 exhibitors and four show floor workshops.

In 2012, we set out to attract 1000 visitors over the Show's two days. When the doors closed on the second day, more than 1600 people attended. This year, the target was 2500 and we exceeded that comfortably. More than 3100 engineers came to the Ricoh Arena – more than 1000 of whom visited the Electronics Design Show. Few people expected these targets to be met, let alone beaten.

Pete Lomas, designer of the Raspberry Pi, said: "It's great to see an exhibition like this getting a proper foothold in the UK."

When the Electronics Design Show was launched, Findlay Media said it was an idea whose time had come. The success of the event justifies that claim. But we're not going to leave it there. There will be another 1000m² of floor space added in 2014 to house the Embedded Design Show. This brand new event will link suppliers of embedded software and hardware with design engineers, allowing the latest thinking in this sector to be shared.

Visitors to this year's Electronics Design Show had a choice of conference keynotes and show floor workshop sessions. Leading off Day One of the Conference was Raspberry Pi designer Pete Lomas, who discussed with a standing room only audience some of the challenges involved in creating the device and then getting it manufactured. Lomas also gave some examples of how students are using the Pi and the future for the device.

Taking the device to a wider international audience is proving a challenge: Brazil, in particular, has huge potential, but import duties are making it too expensive. Would manufacturing in Brazil be viable, he wondered.

Andy Gothard from XMOS then discussed the EthernetAVB standard and its relevance to automotive and industrial designs.

Ian Reid from Plastic Logic proved another popular presenter, with audience participation required to blow up balloons. Reid pointed out the benefits of flexible electronics – and not just for the displays sector. Issues discussed by Reid included conformal displays, large area lighting and automotive opportunities.

Continuing the automotive theme was Andy Birnie from Freescale's East Kilbride site – the company's global automotive R&D centre of excellence. Birnie discussed whether the driverless car is a reality. Stepping through the various issues, Birnie focused on the market factors fuelling the development driverless

"It's great to see an exhibition like this getting a proper foothold in the UK."

Pete Lomas

cars, including fewer deaths on the roads. But the driverless car will need sensor fusion and high speed data processing, not to mention faultless software. Is the driverless car a reality? "If we are ready for it, then yes," Birnie concluded. But as one contributor asked: "Is there anyone in the room who has written bug free software?"

The next presenter, Chris Hills from Phaedrus, picked up this theme, discussing what is 'as low as is reasonably practical'. It's a phrase that appears in safety critical related standards. His view is that anyone writing safety critical software should also hire a lawyer to understand the risks and the

liabilities. "Spend money up front," he advised.

Concluding Day One, Gary Bentley from Littelfuse explained how to increase the reliability of led based lighting designs.

Kicking off Day Two was ex ARM ceo Warren East, now chair of the ESCO Council. The Embedded Systems Community, or ESCO, was the subject of an extensive report published earlier in 2013. East updated the audience on progress, discussing such issues as how to make electronics more visible to the general public and how to help small companies make the most of the opportunities.

Trevor Martin from Hitex then took the audience through a tour of ARM's Cortex-M mcu family. In particular, he looked at the potential for the Cortex-M0+ core to replace 8bit mcus and the change in culture needed.

Exploring the opportunities for electronics and software in surgical innovation, Fabien Schmitt from PDD pointed out such potential pitfalls as the long FDA approval process.

Matthew Bailey talked about the challenges of linking together the predicted 50billion devices in the internet of things and Willy Van Puymbroeck from the European Commission explained some initiatives designed to encourage Europe wide collaboration.

Day Two concluded with Greg Reed from UL International discussing counterfeiting and the need for vigilance. Be aware, he noted, about the effect on brand reputation and the degree of public liability you might incur.

Well attended workshops on the show floor – many of which were full houses – drilled deeper into technology. Those attracting most interest addressed emerging communications protocols, but there was also a lot of interest in the need for engineers to think more how their designs impact on the product lifecycle: particularly test and manufacturability.

For more on the 2014 events, go to:
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THIS YEAR'S SAME FORUM ADDRESSED THE TECHNOLOGIES UNDERPINNING THE 'INTERNET OF THINGS'. LOUISE JOSELYN REPORTS FROM SOPHIA ANTIPOLIS.



"System development without prototyping is too risky today."
Frank Schirrmeister

Opening the recent Sophia Antipolis Microelectronics Forum (SAME), SAME president Jaques-Olivier Piednoir said: "We are surrounded by a cloud of internet data and we use smartphones, pcs and tablets to interact with it. But the world is still analogue – and its physical nature is captured and transformed into data by sensors."

The first paper, 'Conversations with things', presented by Jean-Christophe Dupuy of NXP Software, emphasised the point. "People are analogue, however logical they may be", he said. The logical approach, he believes, is to use technology to make communication with digital objects more intuitive. In fact, Dupuy believes the voice and the microphone will be 'the next big thing'. "We're hardwired for analogue experiences," he said, emphasising his view that voice is the most effective interface. In his vision of the future, devices will listen to people, understand instructions and learn, while communicating intuitively.

Smart devices of the future will have tiny voice enabled I/O systems that draw almost no power. "Of course, they will continue to process data digitally," he added. He also sees audio as the way forward for communicating with smaller devices, such as wearable gadgets, light bulbs and thermostats, obviating the need for touch or gesture recognition. "Simple microphones should be regarded as sophisticated sensors," he asserted.

Techniques such as noise cancellation and noise filtering are under continuous development at NXP Software. The company is working on voice enabled empathic, cognitive machines – "machines that know how warm you like your house, how you like your coffee," he stated.

Scepticism was apparent from some attendees, primarily concerning the computational overhead required for voice enabled smart devices, as well as how to overcome the training and learning challenges of language and accent issues in voice recognition.

A keynote address from Cadence group director Frank Schirrmeister explored the verification challenges and choices for SoCs targeted at 'internet of things' applications. Whether 'simple' microcontrollers

combined with sensors, or complex mixed signal application processors, the software and verification effort is growing in importance, Schirrmeister explained.

"SoCs for IoT typically require integrated sensors, wired and wireless connectivity, 32bit functionality and performance, embedded memory and advanced security," he said. "Energy efficiency, for 'always on' devices and low cost, is critical too," he added.

Software development has to start earlier in the product development cycle and both hardware and software verification and debug are a continuous process, according to Schirrmeister.

"System development without prototyping is too risky today," he said. But the choice of tools, for hardware, software, virtual and physical prototyping, for integration, verification, optimisation and debugging at various stages during product development, can be bewildering. In addition, Schirrmeister said, engineers will have different requirements at different times, as well as different skills.

He highlighted the pros and cons of a number of options, including software development kits, virtual prototyping, fpga based prototyping and board level prototyping. There is always a trade off between speed and accuracy, between hardware and software requirements and the best way and point in the development cycle to find bugs as early as possible.

'The agony of choice' – as Schirrmeister entitled his address – is being addressed by Cadence with its vision of hybrid verification solutions. "No one product fits all needs," he said.

A second keynote, 'Beyond programmable logic', was presented by Steve Trimberger of Xilinx. He warned SoC designers that simply moving to the next technology node may not provide the gains they have come to expect through Moore's Law. "Yes, we still get more transistors," he said, "but there is less area improvement with each new node and, importantly, the cost per gate is no longer falling." Trimberger's advice is to make sure designers do more with the transistors they get from the next process node.





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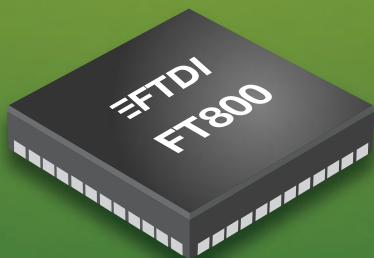


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Empathising with

Giving robots the ability to respond to human emotions is showing potential in autism therapy. **Tim Fryer** met Zeno – the robot that smiles back!

The autistic spectrum is sometimes, mistakenly, thought of as a gauge on which we all have our own place. Such a spectrum, you would have thought, must have the behaviour of a standard human being either at one end of it or bang in the middle. But this is not the case; it is a spectrum that deals with excesses of behaviour and there is a wide range of different behaviours. A slightly over enthusiastic attitude towards *Star Trek*, for example, doesn't necessarily mean you have autism, just perhaps enjoy a bit of escapism.

Autistic people can be loud and intelligent, and can also be quiet and have learning difficulties. There are about 700,000 people in the UK with autism, or 1 in 100, and studies in the US suggest the figure is nearer 1 in 88. Males are five times more likely than females to have the disorder. According to the web site of the National Autistic Society: "Autism is a lifelong developmental disability that affects how a person communicates with, and relates to, other people. It also affects how they make sense of the

People with autism may also experience over or under sensitivity to sounds, touch, tastes, smells, light or colours

world around them. It is a spectrum condition, which means that, while all people with autism share certain difficulties, their condition will affect them in different ways. Some people with autism are able to live relatively independent lives but others may have accompanying learning disabilities and need a lifetime of specialist support. People with autism may also experience over or under sensitivity to sounds, touch, tastes, smells, light or colours."

Communicating with people, particularly children, with autism is obviously a problem, as communication difficulties are at the heart of the disorder. Speech development is often delayed in autistic children, resulting in them being less willing to use it as a form of communication and making them appear shy or unresponsive. Alternative ways of communicating, like using gestures for example, can therefore be more effective.

This is where Zeno comes in.

Zeno and his female friend Alice are two foot high robots that can communicate in ways that humans are not always



The many faces of Zeno – shocked, sad and happy.

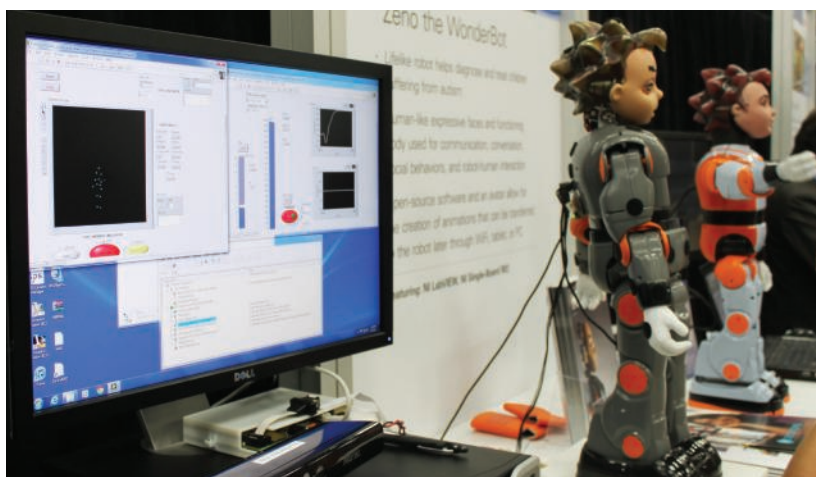
doesn't get frustrated when kids act up, which some therapists do, and the robot doesn't get tired. Other robots that don't have faces are trying to do some of the same types of therapies but, instead of trying to show the kids what a smile looks like, they dance around and act happy. Here, you can really replicate facial expression, movement and gesture in a way that is not overwhelming to a child with autism – dealing with people directly for them can be overwhelming."

Zeno's face is remarkable. It is covered in a material created in house called Frubber. The patented silicone elastomer is designed specifically to look, move and feel like human flesh. "It is one of the enabling technologies that allows us to do facial expressions with quality and realism," said Margolin. "The facial expression aspect is mostly mechanical and is something we are expert in. We think we are the best in the world with respect to facial mechanics and being able to do it in a package like this doesn't require things like a pneumatic power generator."

More challenging is the artificial intelligence. Watching the emotional response to what the robot is doing and analysing that in real time enables researchers – and ultimately therapists – to see how effective the therapy is at that moment. Is the child getting bored or overwhelmed and can the therapy be modified during the process to be more effective?

"It is actively individualising all the time," claimed Margolin. "We are using visual motion recognition and movement cues from the individual we are doing the therapy with. So we are looking at facial expressions, we are looking at movement – is it jerky for example? We are looking at opening the system up in a way that you can work with a number of internal and external sensors for the robot and we are looking at direct bio-feedback – like heart rate, respiratory rate and skin response (amount of sweat) – to measure how the person is feeling. What we are trying to do, and we are getting better at it, is to develop a theory of mind about the individual we are working with so we can deliver the therapy effectively; deliver the information we are trying to get across in a way that works for that person. We build up a profile of that person as time goes on."

The LabView based interface for remote control



able to. The robots, developed by Hanson Robokind, are aimed at a variety of applications in education and health. Director of engineering and cofounder Richard Margolin commented: "Autism therapy was one of the applications that we were aware of when we started. We had developed bigger robots in the past that were much more expensive, so our first goal was to take all of that technology and make it available to researchers in a smaller package that was much more affordable – reducing it by a factor of 10 from \$250,000."

Initially, Robokind's goal was to develop a robot as a tool for researchers and for internal use. Aside from the hardware, the company undertakes artificial intelligence development. It became clear there were two immediate areas where the robots could be particularly useful. Firstly, in education, as the US has introduced new STEM standards which lend themselves to practical robotics and, secondly, for autism therapy. Autism is not something that has a cure, so the focus is on management and therapy.

Margolin explained: "For autism, our focus is on social interaction therapies. In autism one of the areas that tends to be deficient is natural social interaction. Our robots, with expressive faces and the ability to gesture and interact verbally, can teach in a repeatable way. Additionally the robot

Zeno is loaded with sensors. He has a CMOS digital HD camera in each eye, each of which can turn independently, giving researchers the option of stereoscopic vision by adjusting the focal length. There are microphones in the ears, two IR distance sensors in the waist for obstacle detection and ultra sensitive push button sensors in the feet – ideal for robot soccer! On the bottom of the feet are two more sensors on the back for 'ground detect' to let the robot know that when it thinks it has put its foot on the ground, it actually has.



There is also a three axis gyrometer, three axis accelerometer and three axis compass. On the front of the feet there are flip detect sensors. "We don't want him to walk off the end of a table – he is a big heavy expensive piece of hardware," Margolin pointed out.

Josh Jach, director of electronics, said that, for him, a key challenge has been power management. "Each motor has a maximum current draw of 2A and, with 21 motors, that is more power than you want to deliver from a household ac/dc adaptor. We have to ensure each motor uses just what it needs and manage the system so that it will maintain the most critical motors at all times. The legs for example – you can't cut power off there. Each motor has its own controller which feeds back how much current it is currently pulling and that allows us to do management through the software."

The motherboard is currently based on a X86 Intel Atom Z530 1.6GHz CPU with 1Gbyte of DDR2, 4Gbyte of flash and a 16Gbyte SD micro card. Jach said: "In future, we are moving from the Atom to a more versatile TI OMAP chip. It is more power efficient and less costly, a more cost efficient product will need more power efficiency – more MIPS/W is how we look at it."

The OMAP platform includes two ARM Cortex-A processors and two Cortex-M series, the former providing processing power and off loading appropriate tasks to the more power efficient Cortex-M.

Jach continued: "The Intel Atom pulls 1A on standby and 2A when it is running all the software, and that is just because the Intel architecture is not that power efficient. It is equivalent to one or two motors. The ARM platform draws about 100mA, which is a lot lower. We also have three fans on the back of the Intel and a huge heatsink; there is only a tiny heatsink on the ARM and no fans. It just needs natural convective cooling. In a quiet room the fans are quite loud and off-putting for an autistic child."

The University of Texas at Arlington (UTA) is leading the research into this form of autism therapy, with partners that

"We don't want him to walk off the end of a table – he is a big heavy expensive piece of hardware"

Richard Margolin

include Hanson RoboKind, Dallas Autism Treatment Centre and Texas Instruments. Jach noted: "UTA has implemented a Kinect based feedback to the robot to pick up the therapist's movements and relay them to the robot. So you can have a therapist in a remote location feed back a session in video through the eyes. We also have National Instruments' LabVIEW hooked up and accessing any function that the robot can do. The robot is sending animations via LabVIEW wirelessly over 802.11n; effectively it is being used as the control software."

Margolin added: "We use LabVIEW in the build process of this robot; our robot calibration software is basically an automatic calibration suite that runs in LabVIEW, connects to the robot, runs it through this test procedure and then generates all calibration files for each robot. Our model is to keep all of our software open source and it is only our content that we are keeping closed – like our programmes for high schools. But anyone who wants to download our software for conversational interactive stuff, our motor and motion control, our vision; they can do that from the web site."

It is early days, but Margolin believes Zeno and Alice may have their place in autism therapy. "We have thus far conducted a number of efficacy studies that have shown this is worth pursuing and we are now actively in a number of places working directly with children with autism. We are a Dallas based company and at the Dallas Autism Treatment Centre has about 75 children with autism concentrated in one location, so we have been working with them."



The power cable is for charging - Zeno is powered by two batteries. Ethernet, HDMI and USB connections are all available but Zeno can also communicate wirelessly.

Let's look at the problem

Developers of medical devices need powerful integrated embedded SoCs and a clear embedded roadmap. By **Zeljko Loncaric**.

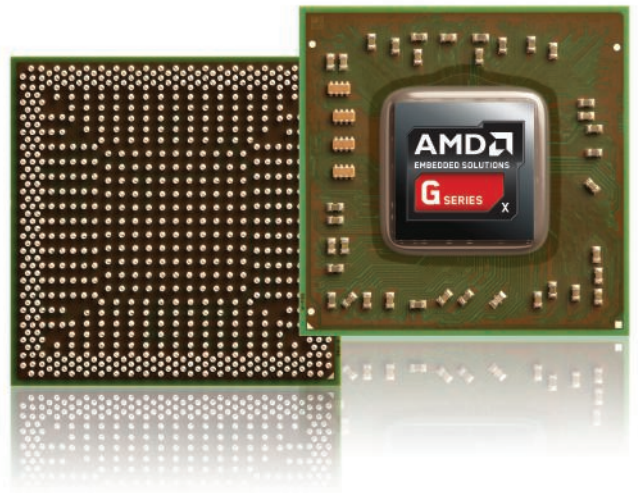
Medical devices and medical pcs need to become more powerful, faster and smarter, with the goal of saving money and improving patient care. This is being made possible through the development of smaller, more powerful processors that enable wider use of computer technology; for example, in the home care sector.

There are many medical applications which require particularly fast data processing and visualisation; examples include emergency service vehicles, during hospital consultations, at the bedside or in the operating theatre. This applies to stationary and mobile medical devices alike, whether compact ultrasound devices, medical tablet pcs or patient data

The conga-TCG Type 6 COM Express Compact module is suited to use in mobile systems with medium performance requirements

monitoring systems. With better display resolutions, more data from diagnostic imaging systems and higher information density in visualisation applications, embedded processors must be capable of processing and presenting more and more graphical source data. At the same time, devices need to become more compact, energy efficient and cost effective in order to succeed in an increasingly mobile and wider field of application.

Meeting these needs requires the provision of more computing power in a smaller footprint. Classic pc processor cores, such as the AMD G-Series SoC platform, which integrates two or four cores, are well suited for traditional IT

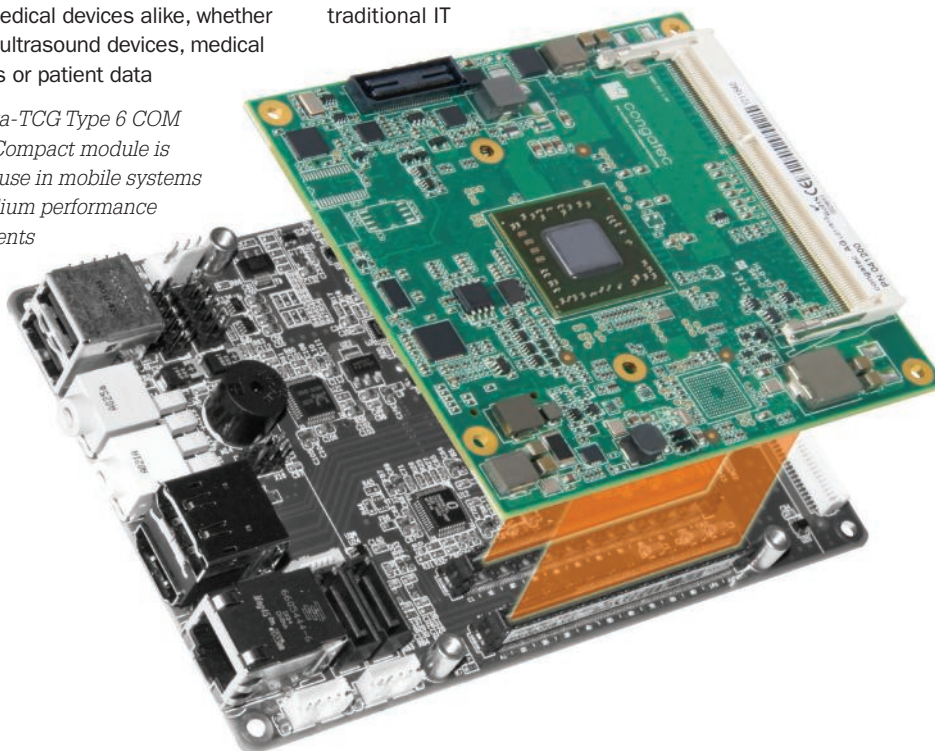


The AMD G-Series SoC platform integrates cpu, gpu and I/O controller

tasks, in particular the rapid execution of applications such as radiology information systems, hospital information systems, picture archiving and communication systems and MS Office programs. In these applications, AMD G-Series SoCs can double the cpu performance available from AMD Embedded G-Series APUs.

While overall computing power is important, when it comes to processing and displaying two and three dimensional image and video data, there are more efficient cores, such as those provided by the integrated AMD Radeon graphics processors. Despite its compact size, the AMD G-Series SoC platform features powerful graphics processing: up to 20% more performance than available from AMD G-Series APUs.

In addition, AMD has designed the SoC platform as a programmable, high performance parallel data processing unit. Typical applications include image processing tasks in diagnostic workstations and image generation



from sensor data in ultrasound devices and radiology systems. For such applications, the integrated gpu provides up to 256GFLOPs via OpenCL APIs. Physically, the SoCs, manufactured using 28nm technology, require only 600mm² of pcb space and integrate an I/O controller. The processor also implements standard interfaces such as PCIe, SATA and USB3.0.

While they bring a number of benefits, the latest processors also present medical device developers with a number of practical challenges. These include: high integration density, with barely resolvable pin grid array interfaces; extremely high clock frequencies; and a higher slope. Implementing these parts into medical applications can often require specialist know how that is rarely the core competency of a medical device manufacturer. It therefore makes practical and economic sense to buy the critical 'core module' as a preintegrated computer on module (COM).

The experience of the module supplier and the effects of consolidation translate into a number of benefits for device manufacturers, including:

- Scalability, through module interchangeability
- Preintegrated platform
- Drivers and board support packages for several operating systems.
- Shorter development times and reduced time to market
- Higher quality

It is also useful for other system components to be preintegrated on the COM or for users to have the option to configure them. This applies in particular to battery management systems in battery powered or battery backed units.

For applications requiring higher graphics performance, a COM Express Type 6 Basic module makes the best use of the AMD Embedded R-Series APUs. Alongside powerful graphics, the modules offer excellent performance/Watt values. The conga-TFS, for instance, offers superior graphics representation for a range of medical applications.

Connecting seamlessly to the performance available from the conga-TCG, the conga-TFS allows developers to benefit from scalability when designing products ranging from low power mobile devices to stationary high performance systems. The integrated graphics core supports DirectX 1.1 and OpenGL 4.2 for fast 2d and 3d displays supporting resolutions of up to 3940 x 2160 pixels. This allows them to be used in sophisticated diagnostics workstations or in preoperative systems.

Meanwhile, existing medical systems may need to be upgraded. Some of these may use ETX format boards, with an ISA bus, or XTX format, without ISA. Upgrading these systems allows them to be equipped

with modern graphics and computing power and congatec has developed the ETX COM conga-EAF and the XTX COM conga-XAF for this purpose. Both modules, based on AMD G-Series APUs, are available with single or dual core processors and thermal dissipation of less than 18W.

By combining graphics and processor technology in one package, AMD has developed efficient x86 based SoC solutions suitable for a range of medical applications. With a clear roadmap and success with semi custom designs, AMD has a sound solution for the medical sector.

Author profile:
Zeljko Loncaric is a marketing engineer with congatec.

Open wide, please

Until recently, desktop computers needed special hardware to enable medical image data to be visualised. However, the latest embedded systems can handle these tasks and consume less power. White Lion Technologies has taken advantage of this ability to develop a dental chair with a COM system and a high resolution touch screen.

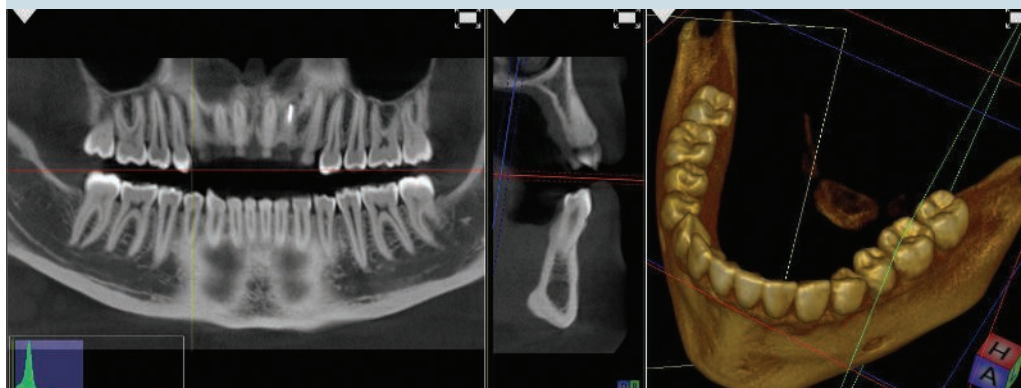
In addition to accessing general patient information, the dentist can view and modify case specific data during examination. Images taken by an intraoral camera can be displayed or stored and data from digital volume tomography (DVT) devices represented. DVT captures image slices using an X-ray tube which rotates around the patient and an opposing detector. Using cone beam reconstruction, a volumetric dataset can be generated and stored in high resolution.

The system takes advantage of OpenGL to represent high resolution volumetric data and to enable live modification of display parameters. To enable this, a raycaster was written as a shader for the graphics card. This sends virtual rays in the direction of the patient's 3d line of vision through the DVT volume, accumulating colour and transparency in the process. To make the

representation even more realistic, it is possible to analyse the surrounding voxels (volumetric pixels) and produce a shading effect. Depending on the system settings, it is possible, for example, to represent a patient's dentures or to see root fillings of individual teeth.

The raycaster sends many simultaneous rays through the volume, with the image generated using data from the complete cycle. Since this is usually done at 30 frame/s and with a volume of 5123 voxels, the dentist can see a high resolution virtual model of the patient, rotate it and adjust parameters relevant for the treatment. By applying intelligent algorithms, practitioners can determine certain anatomical properties, including nerve channels, or show a panoramic view of the jaw structure.

congatec expects that cpus and gpus will continue to merge into high performance embedded systems. In the future, embedded systems with APUs will be able to handle extremely compute intensive cone beam reconstructions and it should also be possible to account for any unintended patient movement during recording. And a further benefit will be the development of algorithms which allow the radiation dose to be reduced.





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Good things, small packages

Selecting the right package for a chip isn't as easy as it used to be. By **Graham Pitcher**.

There are a number of elements in the electronics world which have a higher priority than was the case some years ago – and it's certainly the case when it comes to packaging leading edge chips. Patrick McNamee, vp of silicon operations for envelope tracking (ET) technology pioneer Nujira, explained: "The days have gone when you could finish a design, then look at what kind of package – bga or tqfp – you could put it in. Companies now have to know the package from the start of the design process. Even with our 'Gen 1' product, we were already pushing the design rules when it came to packaging."

'Gen 1' is the Coolteq.L NCT-L1300 ET power supply chip, which entered volume production earlier in 2013. This device is already being upgraded, with the working title of 'Gen 2'. And the Cambridge based company has to decide how to package it.

"We certainly had some packaging challenges with Gen 1," McNamee observed, "and these have sharpened

with the latest design. Gen 2 will support higher bandwidths and more power in a smaller footprint, but has to be thin enough to go into a smartphone and meet the phone builder's cost targets. The process will be a lot more challenging and we are thinking very carefully about how we proceed."

The L1300 comes in a wafer level chip scale package with a 0.4mm ball pitch. "It's essentially a fast very high bandwidth op amp," McNamee pointed out. According to the plans, Gen 2 will support twice the bandwidth of the L1300, but will be manufactured using the same process geometry. "With twice the bandwidth," McNamee continued, "Gen 2 will create a harsh electrical environment and we will have to control the parasitics more closely. While the die is getting smaller as we simplify the design, we still have to deal with a peak power of around 1.2W." With the device more susceptible to stray inductance, McNamee said the packaging challenges increase.

With a choice of packaging options for Gen 2 being narrowed down, Nujira still has one big issue on the table – thermal management.

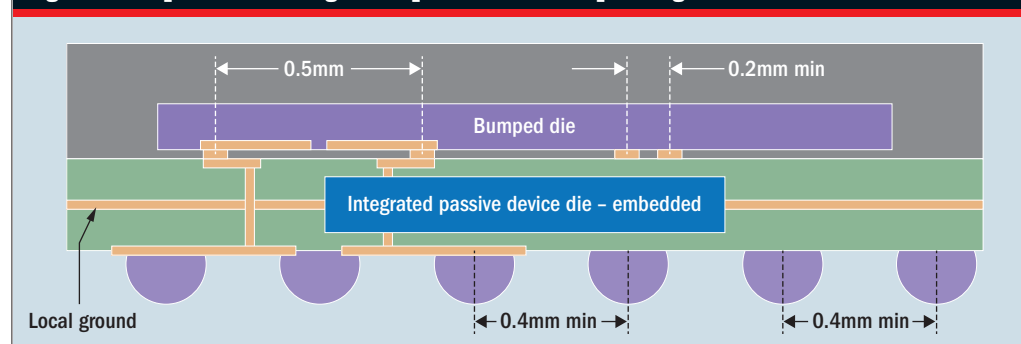
Parasitics can be controlled by careful placement of capacitors around the device. Ideally, those capacitors would be on chip. "But we can't get large enough capacitors inside the package, otherwise the die would be too large. That means we have to think about routing; Gen 2 is already I/O constrained."

So where does Nujira go when it comes to deciding on packaging technology? One approach is to enlist the help of specialist packaging houses and Nujira has selected ASE as its production packaging partner for Coolteq.L devices. As part of the deal, ASE is helping Nujira to achieve its packaging objectives quickly and effectively. McNamee said: "Moving into volume production is a huge step, so it is critical that we select world class supply chain partners. As the world's largest semiconductor packaging and test company, ASE offers us the expertise, capacity, reliable quality and cycle time we need to address the high volume, fast moving smartphone market."

Nujira is currently using ASE's flip chip wafer level chip scale packaging (wlcsip) technology for its Coolteq.L ET chips, but that's not likely to continue with Gen 2. WLCSIP has been used broadly for nearly a decade and has developed into a reliable packaging technology with



Fig 1: Example of an integrated passive device package construction





Inspection of wafer level chip scale packaged devices at ASE

Image courtesy ASE

high yield. But it has drawbacks, including routing parasitics. "Some packages will just not be suitable for Gen 2," McNamee stated. "Any way we do things, we will not get enough control to give repeatable performance from the device. A lead frame helps, but you still can't get the performance you need."

The benefit of wlscsp for Gen 1 parts is that it's cost effective and there are no bond wires. "So we can control the parasitics because we control the routing. But we don't have control over access to the outside world."

A possible solution is flip chip system in package (fcsip). This would require Nujira to build a module, a more costly approach with some routing issues, but a choice which brings control over placement of critical passives. Other issues include device height and a larger than ideal footprint. "We have more control with this technology, but it's quite expensive," McNamee observed, "and customers get worried about 'margin stacking'." FCSIP would allow some passives to be integrated into the device, but margin stacking reflects the 'handling charge' for this. "But it has potential," McNamee admitted.

Two variations on the fcsip theme offer a bit more hope. Copper pillar fcsip is offered by ASE as a way to meet demand for smaller, thinner,

"We certainly had some packaging challenges with Gen 1 and these have sharpened with the latest design"

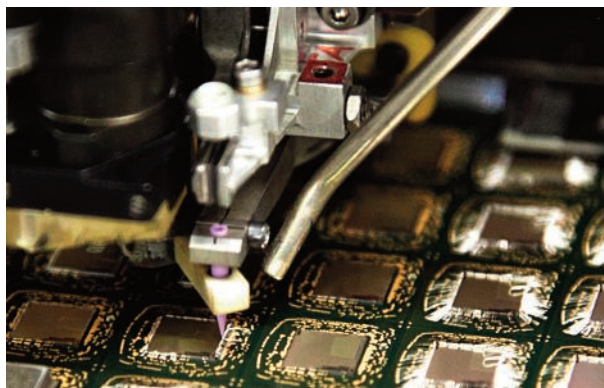
Patrick McNamee



lighter and higher performance packages. According to ASE, this is the most effective method for fine pitch interconnection in flip chip packages – enabling ball to ball distances of 0.2mm.

"We'll be looking at this," McNamee commented, "because Gen 2 will be I/O constrained. But our device will need to use a 0.4mm pitch, otherwise pcb costs will be driven up. So we need to use something like an

Copper wire bonding during the packaging process



interposer to increase the pitch."

The other version is two sided copper pillar, with discretes on the bottom. "This has a lot of advantages," McNamee said. "We have looked at this in depth and might come back to it at some point. It ticks a lot of boxes, but it's more expensive."

The ideal solution for Nujira would be some process which supports embedded components – whether the die itself or passives. "There aren't many companies running such processes in volume," McNamee observed. "They are expensive and exotic, but do provide a solution to the electrical problems. However, those running them tend to be companies with cheap dice who can afford to lose some in the packaging process."

Embedding passives within a substrate inside the package means no bond wires, control of passives placement and hence, good parasitic control. A similar approach can see a die embedded within the substrate, but questions remain about yield. Another variant is embedding integrated passive devices, or IPD, within the substrate. "IPD is very interesting," McNamee said. "But one of the challenges is getting the correct value of capacitors and inductors at 2.4GHz; you don't always get what you expect."

A solution to this challenge is being developed by French company IPDIA, a spin off from NXP "It's an expensive approach," McNamee said, "but it's a very good process – it's the equivalent of FinFETs for passives."

With a choice of packaging options being narrowed down, Nujira still has one big issue on the table – thermal management. With a device handling a peak power of 1.2A, heat is an issue. "We're still looking at it," McNamee admitted. "We're still running models, but should have the results in the next few weeks. Then, we can finalise our decision."

Nujira started looking at Gen 2 at the end of 2012. "It's taken six months to research, consider the options and narrow the choices," McNamee concluded. "The process should be complete by the end of October. It has taken a long time, but it's a challenging project."

Black is the colour

Simplifying real world interfacing using a Linux based development board.

By **Kyle Borgerson.**

Embedded microcontroller development boards are a popular, low cost way of getting to know an mcu architecture. Meanwhile, 8bit boards, such as Arduino, provide an easy way of getting to know the basics of programming and the components needed to interact with the real world.

Such development kits and evaluation boards have been available to professional developers for years, but the benefit of popular, yet simple, mcu boards to professional developers has always been in doubt. However, more capable, open source boards have started to appear and are gaining support from professional developers.

Based on a microprocessor, rather than an mcu, these newer development platforms are typically Linux based. One such example is TI's BeagleBone Black. It not only offers a platform for prototyping Linux applications, but also comprehensive IO support, making it perfect for designs that interact with the real world. The BeagleBone board format, initially released in 2011, not only squeezes in all of the capabilities of earlier BeagleBoard systems into a credit card sized package, but has also established a standard footprint of two dual row 46pin connectors for expansion modules called 'capes'. Similar to the Arduino 'shields', they support a variety of plug in boards to add more advanced I/O.

BeagleBone Black features TI's Sitara AM3359, an ARM Cortex-A8 microprocessor running at 1GHz. There is also 2Gbyte of flash and 512Mbyte of DDR3 at 400MHz. A micro D type HDMI connector, Ethernet and USB ports are included and the board is powered by a 5V dc supply. The board can also be USB powered, since it consumes no more than 250mA.

From the software perspective, the board comes preloaded with a range

of software and is ready to boot. Once powered up, the board boots the Angstrom Linux distribution, after which the Gnome desktop appears. During the boot process, the four user LEDs (USR0 to 3) will flash reassuringly to indicate activity. In addition to Linux, the Black can also run Ubuntu or Android.

Most developers are likely to have an IDE that supports the TI Sitara A8, such as those from IAR Systems or Green Hills, but TI's Code Composer IDE is also a natural choice. However, a number of tools are supplied with the BeagleBone Black that allow you to become familiar with the board.

Preloaded development tools include a Python interpreter and C/C++ compiler, along with a local replica of the Cloud9 IDE preconfigured to run

Borgerson:
"With its open source approach, the BeagleBone Black provides a cost effective and well documented route for prototyping a commercial design."

Node.js. Also included is the Bonescript library, based on Node.js, which provides a number of Arduino like functions for interfacing with the hardware. Readers familiar with Arduino's 'digitalWrite' function will recognise this and similar functions included within Bonescript. The beagleboard.org community resource also serves as a useful repository of example projects, helpful forums and hardware/software documentation.

These tools, and the capability to use the board's extensive GPIO, earn respect from professional embedded developers. The device has 92 pins accessible via the two dual row headers P8 and P9. These headers also form the connections to the capes. These pins can have many different possible functions, from

Fig 1: The BeagleBone Black's major components

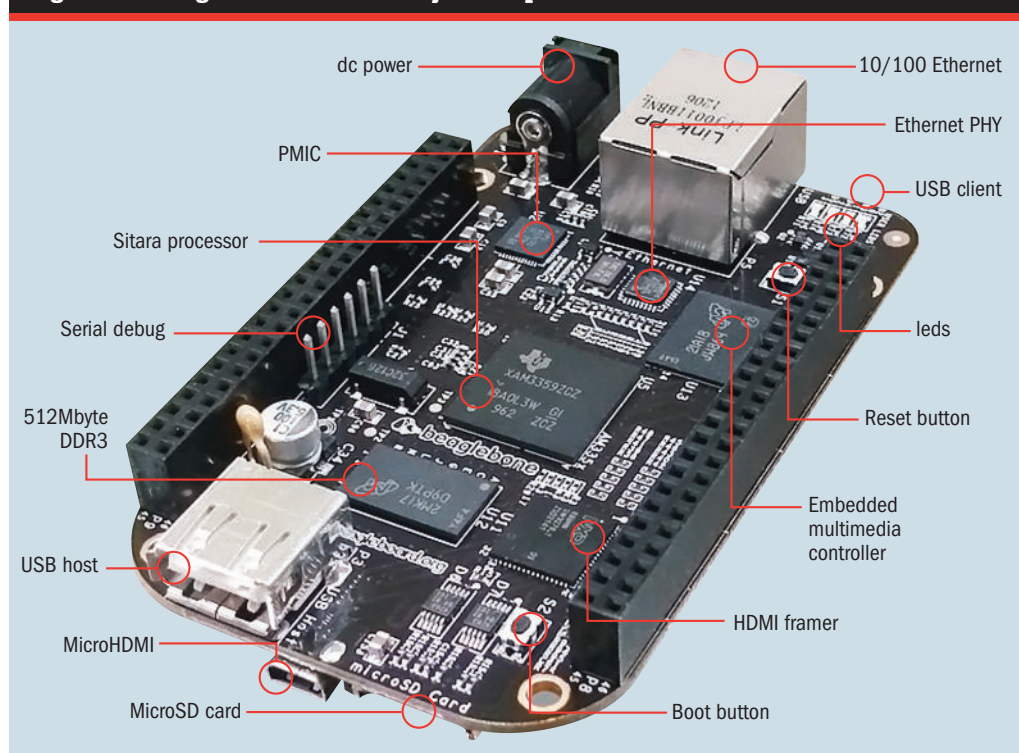


Fig 2: BeagleBone Black block diagram

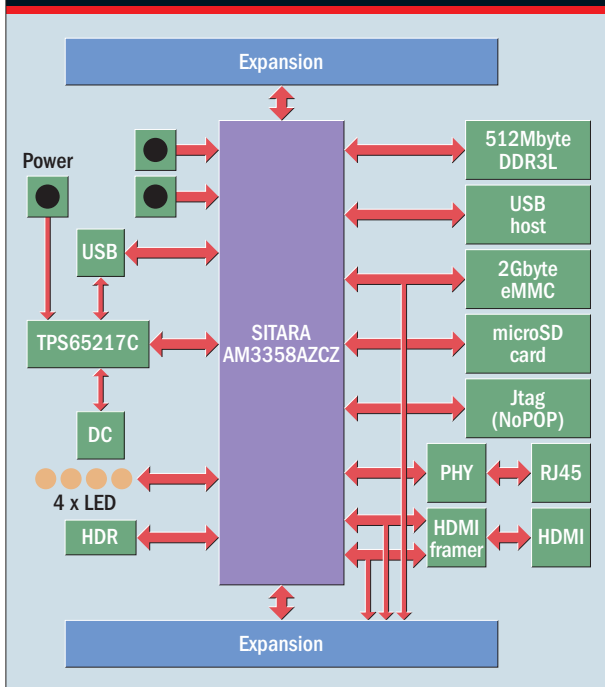


Fig 3: The 'blinked.js' code example

```
require('bonescript');
ledPin = bone.USR3;
setup = function () {
    pinMode(ledPin, OUTPUT);
};
loop = function () {
    digitalWrite(ledPin, HIGH);
    delay(1000);
    digitalWrite(ledPin, LOW);
    delay(1000);
};
```

Fig 4: Example commands over SSH to control a GPIO pin

```
root@beagleboard:~# cd /sys/class/gpio
root@beagleboard:/sys/class/gpio# ls
export  gpchip0  gpchip32  gpchip64  gpchip96  unexport
root@beagleboard:/sys/class/gpio# echo 46 > export
root@beagleboard:/sys/class/gpio# ls
export  gpchip0  gpchip32  gpchip64  gpchip96  unexport
root@beagleboard:/sys/class/gpio# cd gpio46
root@beagleboard:/sys/class/gpio/gpio46# echo out > direction
root@beagleboard:/sys/class/gpio/gpio46#
root@beagleboard:/sys/class/gpio/gpio46# echo 1 > value
root@beagleboard:/sys/class/gpio/gpio46# echo 0 > value
root@beagleboard:/sys/class/gpio/gpio46#
root@beagleboard:/sys/class/gpio/gpio46# echo 46 > /sys/class/gpio/unexport

root@beagleboard:/sys/class/gpio# ls
export  gpchip0  gpchip32  gpchip64  gpchip96  unexport
root@beagleboard:/sys/class/gpio#
```

controlling I/O and reading sensors to driving leds. Third party capes provide everything from a simple breadboard area and an lcd screen to a cape which can control underwater vehicle projects. Up to four capes can be stacked on top of each other, as long as there are no GPIO conflicts.

The easiest way of experimenting with this GPIO is to use the Cloud9 IDE. Cloud9 starts automatically at boot time and is accessed using the Black's web server. The Epiphany browser finds the IDE automatically on start, but any browser can be pointed to port 3000. The Black's web server also provides a set of pages that gives access to the Cloud9 IDE and some Bonescript code examples.

Cloud9 provides a number of simple examples written in node.js JavaScript and incorporating the Bonescript library. The 'blinked.js' code example (see fig 3) toggles the USR3 led, but this can be extended to use one of the GPIO pins by connecting an led and associated pull up resistor to the desired pin and by changing the assignment of ledPin to the relevant GPIO, for example bone.P8_3. An entry level IDE, Cloud9 provides a quick and easy way of writing short code projects and then running and debugging them.

The use of node.js JavaScript appears to be the preferred way of programming the BeagleBone Black; it certainly serves as an easier introduction for those unfamiliar with programming or higher level languages,

or simply as a way of pulling together a quick prototype. More experienced programmers and those with a need for a more complex design are supported with Python and C. In the same way that Bonescript adds Arduino style digital and analogue I/O commands to node.js, a library called PyBBIO is available for Python developers.

The GPIO can also be addressed directly from Linux. This could be done directly on the board or remotely over SSH. Firstly, this requires the correct Linux signal name to be identified with a specific GPIO pin and, secondly, an in depth knowledge of working at the Linux command line level. Each GPIO pin will have a directory named with the Linux signal within the /sys/class parent when it is in use. In this way, potential signal/GPIO conflicts can be spotted when one or more capes are being used. For example, if connect P8.pin 16 is identified as GPIO46 and the gpio46 directory does not exist, the signal is available for use (see fig 4).

When driving a led connected to the pin, writing a 1 to Linux value file will turn it on and writing a 0 will turn it off. After use, don't forget to 'unexport' the directory to clear the use of the pin. These shell commands can also be incorporated into Python instructions.

Designers could, of course, use a manufacturer's evaluation kit. Such boards require a lot of set up and knowledge and depend on the availability of example code and documentation from the vendor. This is an area where BeagleBone Black is a better candidate, since TI has encouraged a more open community, with example projects and resources available, as are a range of of capes.

With its open source approach, the BeagleBone Black provides a cost effective and well documented route for prototyping a commercial design. And the open source components are not limited to the tools provided; board schematics, circuit diagrams and Gerber files are available, making the transition from concept to preproduction easier.

Author profile:
Kyle Borgerson is TI product manager for Digi-Key.

Making sense of the data

Debug automotive designs more quickly with CAN-dbc symbolic trigger and decode. By **Johnnie Hancock**.

The differential CAN bus is used extensively in modern cars for drive train and body control. This protocol, developed by Bosch more than 30 years ago, is still considered the 'workhorse' serial control bus of the automobile and has been adopted for industrial and medical equipment control applications.

The primary measurement tool used to test and debug the physical layer of this serial bus is an oscilloscope. Although CAN bus protocol analysers are used for testing and debugging at a higher level of abstraction, an oscilloscope allows you to monitor the analogue quality – or signal integrity – of the CAN bus' physical layer.

The electrical environment in automobiles is naturally harsh, with lots of noise and unexpected transients. Oscilloscopes can capture and show details of those infrequent automotive transients and noise that could be producing CAN bus errors.

To assist in synchronising on and identifying specific CAN frames, most current mid and high range oscilloscopes can trigger on and decode the CAN bus in a hexadecimal and/or binary format. This capability is

typically an option for which you must pay extra.

Fig 1 shows an oscilloscope triggering on and decoding the CAN bus in a hexadecimal format. Note that with the oscilloscope's analogue capture capability, we can see noise as well as various pulse amplitudes. Underneath each captured frame is the time correlated decode trace, telling you the contents of that particular frame. In the upper half of the display is the protocol list, which shows the contents of all captured frames in a tabular format, similar to a traditional protocol analyser's display.

In this particular example, the scope had been set up to trigger on frame ID 0x201, which correlates to 010 000 0001. The 8byte data field of this particular frame (0x201) shows '0B A8 00 00 27 10 00 00'. What does 0x201 mean? And what does that long data string of hex characters mean?

One of the advantages of a CAN protocol analyser is that it can display results at a higher level of abstraction. In other words, it uses human language such as 'speed = 852rpm', not cryptic bits. This can also be achieved on some oscilloscopes. Fig 2 shows the same oscilloscope now triggering on



Oscilloscopes are the primary tool used to test and debug the physical layer of the CAN bus

and decoding the bus symbolically.

In this example, the oscilloscope was set up to trigger on message 'Brake_Torque', which relates directly to a specific frame ID code (0x211). Instead of a long string of hex characters representing the data field in this frame/message, the oscilloscope displays 'signal' names with signed values, units and/or encoded states, such as 'On', 'Off' and 'Reverse'. In symbolic CAN language, a 'signal' is not the movement of electrons; it typically represents a physical parameter or condition, such as 'Total_Torque: 131.0640k ft/lb'. How does the



oscilloscope translate raw bits into symbolic code?

All vehicles have a .dbc file associated with each CAN bus and for each particular vehicle: it stands for 'data base CAN'. A .dbc file is an ASCII formatted file that defines the CAN network. Fig 3 shows a portion of a simple .dbc file created by Agilent.

'Messages' are simply labels that represent specific frame IDs. For instance, frame ID 2190911837 has been defined to be Message: EngineData in this .dbc file. 'Signals' are more complex. Within Message: EngineData, which consists of 5byte of data (DLC = 5), we have defined three signals labelled 'Fuel', 'Temp' and 'Speed'. Each signal has a specified start bit and length. For example, 'Temp' begins at bit 24 and is 8bit long. Also associated with each defined signal are variable conversion factors, units, min and max warning values and a big Endian/little Endian indicator.

In the middle of this file example are definitions of state encoded signals. Referring to Message: ABS, signal 'Frnt-R' begins at bit 7 and has a length of 1bit. This means it can only have a value of 0 or 1. Near the bottom of the file, 'Frnt-R' has been defined to be an encoded state where, if the value of the signal is 0, the oscilloscope will display 'unlocked' and 'locked' if the value is 1.

Although Agilent created the .dbc file shown in Fig 3 using a text editor, there are more efficient ways to do this, especially when creating a .dbc file for more complex automotive CAN

systems. The most common tool in use today is Vector's CANdb++.

Once a .dbc file is available for the CAN network that you want to test and debug, importing the .dbc file into the oscilloscope is easy: simply store the file on a USB flash drive and then recall the file into the oscilloscope. The oscilloscope will then parse the file and save all the important conversion parameters. Note that Agilent's InfiniiVision 4000 X-Series oscilloscope doesn't actually save the entire .dbc file. The oscilloscope's CAN decode and trigger menus will then provide options to turn on symbolic decode and give the ability to trigger on messages and signals on a symbolic level. Fig 4 shows an Agilent oscilloscope triggering on and decoding the built in CAN training signal symbolically using the .dbc file referenced in Fig 3. The lower half of the display shows a zoomed in view of Message: EngineData with signals 'Fuel', 'Temp' and 'Speed'.

Since Agilent's InfiniiVision 4000 X-Series oscilloscope is based on an embedded operating system, it is impossible to retrieve the file from the oscilloscope. Even when connected to the internet via the oscilloscope's LAN port, users can't access the internal cpu flash memory system. In addition, you can easily erase the file using the oscilloscope's standard Secure-Erase feature, which is required by many of Agilent's aerospace and defence customers. Since most .dbc files are protected and propriety, this is a critical security tool for the automotive

Fig 3: A simple example of .dbc file content

```
BO_ 2190911837 EngineData: 5 Engine
    SG_ Fuel : 8|8@1+ (0.01, 12) [0|21] "gal"
Gateway
    SG_ Temp : 24|8@1+ (0.2, 135(-50|150) "C"
Gateway
    SG_ Speed : 32|8@1+ (0.1, 2900) [0|8000]
"rpm" Gateway

BO_ 189 ABS: 8 Brakes
    SG_ Frnt-R : 7|1@1+ (1,0) [0|1] "" Gateway
    SG_ Frnt-L : 2|1@1+ (1,0) [0|1] "" Gateway

CM "CAN communication matrix for power train
electronics
implemented: turn lights, warning lights, windows";

VAL_189 Frnt-R 0 "unlocked" 1 "locked" ;
VAL_189 Frnt-L 0 "unlocked" 1 "locked" ;
VAL_189 Rear-R 0 "unlocked" 1 "locked" ;
VAL_189 Rear-L 0 "unlocked" 1 "locked" ;
VAL_127 Frwd-impact 0 "Deployed" 1 "Armed" ;
VAL_127 Rear-impact 0 "Deployed" 1 "Armed" ;
VAL_127 Left-impact 0 "Deployed" 1 "Armed" ;
VAL_127 Right-impact 0 "Deployed" 1 "Armed" ;
```

All vehicles have a .dbc file associated with each CAN bus and for each particular vehicle

industry. When the Secure-Erase feature is executed, there are no residuals of the .dbc file left in the oscilloscope.

There are many tools that automotive engineers use today to test and debug their CAN based designs. The oscilloscope is the primary tool used to test and debug the physical layer of the differential CAN bus. Using an oscilloscope with a CAN trigger and decode option can speed the debugging and testing process. And using oscilloscopes with the additional CAN-dbc symbolic trigger and decode capability will make isolating particular messages and signals for testing even faster and more intuitive. After all, 'EngineData' makes a lot more sense than 0x0296A95D.

While oscilloscopes with CAN-dbc symbolic trigger and decode won't replace a CAN protocol analyser and vice versa, automotive engineers designing and testing CAN buses in their vehicles and ECUs will typically use both instruments for optimum test.

Author profile:

Johnnie Hancock is a product manager with Agilent Technologies' oscilloscope and protocol division.



Fig 1, far left: Triggering on and decoding frame 0x201

Fig 2, centre: Symbolically triggering on and decoding the CAN bus

Fig 4, left: Recalling the .dbc file into the oscilloscope in order to trigger and decode symbolically.

Smart use for reference

Creating a new product is one thing, inspiring designers to use it is another. **Tim Fryer** talked to CSR about its technology introduction strategy, which recently included an eye catching ultrathin Bluetooth Smart keyboard.

CSR is fabless – it doesn't do end products – yet it comes up with some interesting example designs to show what can be done with its chip platforms. A recent example is an ultrathin touch surface enabled by CSR's single chip Bluetooth Smart solution.

Paul Williamson, director of low power wireless at CSR, said: "We create example designs to show what is possible with the technology, but we never sell or market directly to consumers. It is companies like Nike [which used an earlier version of the same chip in its basketball training shoe] which take it to market. Really, we put this out there as an example design and it has resonated with a lot of people. It is some way from market – maybe about 12 months from where you could take our prototype software and hardware and turn it into a formalised, mass produced product. It is probably a Christmas 2014 product at the earliest."

While the company also supplies the technology for heart rate monitors, weight scales and the like, Williamson concedes they are less likely to capture the imagination. "We want to do things that are innovative;

create things that move the market forward," he added. The touch screen was a collaboration with local Cambridge company Conductive Inkjet Technology (CIT), which has innovative technology and a substantial manufacturing capacity to showcase. It has a two stage additive process for printing circuits directly from digital files. The process patterns a catalytic ink and then immerses the image in an electroless plating solution to deposit solid metal onto the desired pattern.

CIT invested in printing the membranes, whilst CSR designed the pcb layout and radio subsystem. Williamson continued: "Both companies have IP in the technology, but not in the way it is put together – it is not our intention to protect it, it is there to show people what can be done and go and develop their own flavour."

Demonstrating capabilities

Example designs like the touch screen are a useful way for companies to demonstrate the capabilities of their products that may get lost in a data sheet. For example, the 1010 and its larger sibling, the 1011, have the baseband modem built in hardware. Williamson explains the advantages: "That means that our microprocessor isn't being executed just to keep the radio protocol running and that allows us to save a lot of power. A lot of approaches to this market are to build a microprocessor that has to be executed every time you need to pre and post process a packet – every time there is a radio event, you need to spin out the micro at 16MHz before and after an event. We don't do that. We do that at low clock

"Both companies have IP in the technology, but not in the way it is put together – it is not our intention to protect it, it is there to show people what can be done and go and develop their own flavour."

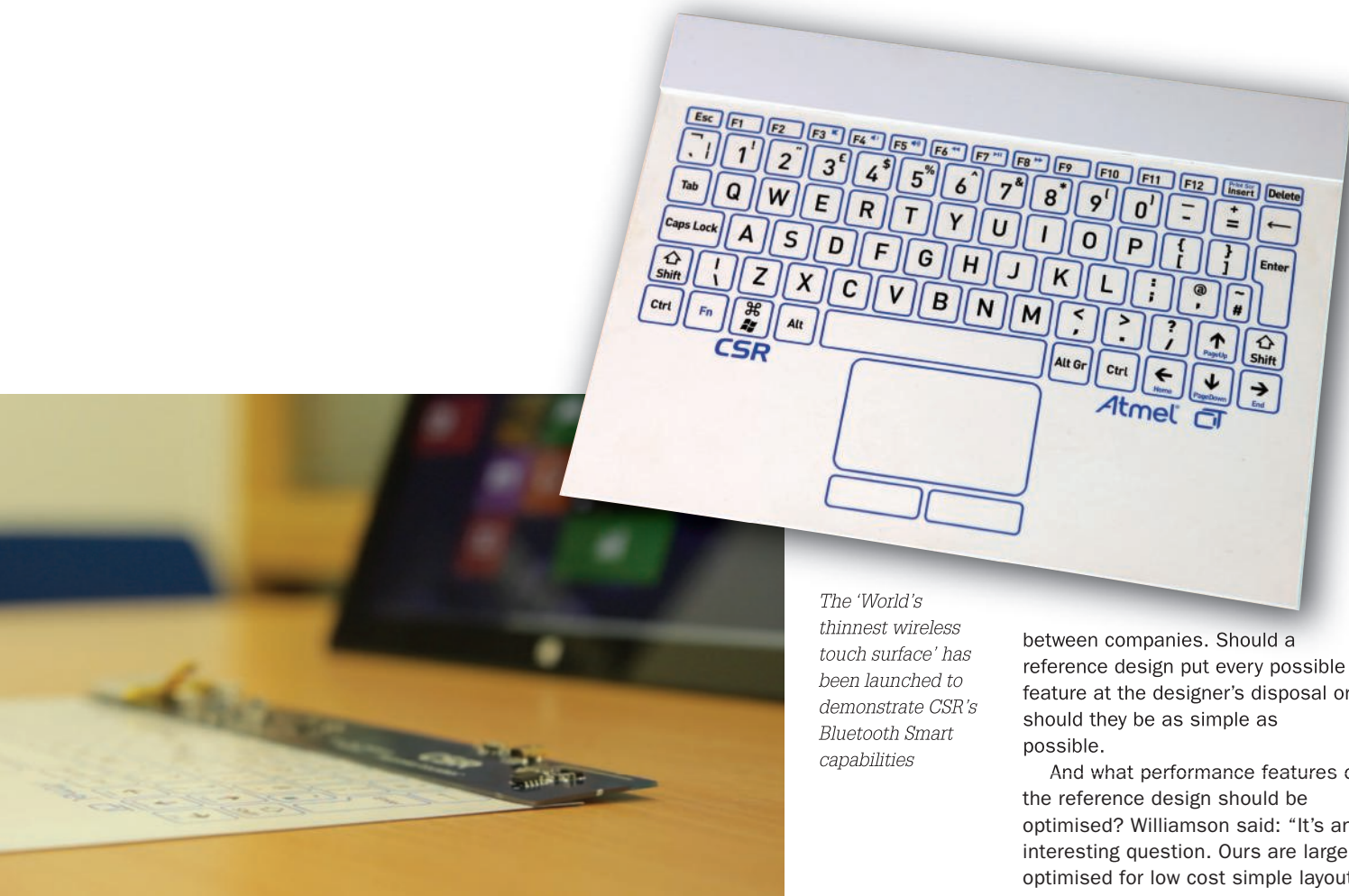


speeds in digital logic so we don't need to run the microprocessor and consume as much current."

There is a 16bit microprocessor which, on the 1010, has 64kbyte of memory that is free for the customer's application. It has a further 64kbyte that are used in rom for the Bluetooth Low Energy stack and protocols. Williamson continued: "There is a series of standard peripheral interfaces and features that you would find on an mcu – including spi, i²c, uart and a 10bit a/d converter – so they can write their application to reside there and drive those interfaces as they please. So it is more than just a radio, it is more of an embedded microprocessor with radio capability."

So how does a company introduce the concept of a product that might not fall under the preconceptions of the market. Clearly having some eye catching design ideas makes a difference – but not everyone will immediately see the relevance of





The 'World's thinnest wireless touch surface' has been launched to demonstrate CSR's Bluetooth Smart capabilities

between companies. Should a reference design put every possible feature at the designer's disposal or should they be as simple as possible.

And what performance features of the reference design should be optimised? Williamson said: "It's an interesting question. Ours are largely optimised for low cost simple layout. There are module developers who will create something highly integrated and expensive, but the guidance with our reference designs is to create something that can go on a one or two layer pcb and be simple and low cost to use. [In these devices] the radio and microcontroller are integrated, so we are optimising to ensure the performance of both.

"We have an integrated switch mode power supply on the device that operates from 3.8V down to 1.8V, so it can take the full capacity from a typical 3V cell. There is component placement to keep the noise and stability of that power supply under control.

"And there is the rf connectivity – we are the only company out there at the moment offering a single 50Ω track out of our device so the antenna can be tuned in software. We do everything we can to make it easy for people to design with the device. And the reference layout is a good starting point for most people."

basketball shoes or membrane touch screen to their products.

For this reason, reference designs can be invaluable and so CSR has released reference pcb layouts for both the 1010 and the 1011. These have been qualified to FCC, ETSI and the Bluetooth SIG standards so that they can be copied and pasted. They also come with a programming interface over SPI and a CSR tool chain and software development kit (SDK) so applications can be written on top, and the SDK comes with a range of example applications covering common use cases of Bluetooth Smart. There is also guidance if people want to rip it apart and do their own thing.

The requirements for reference designs vary, according to Williamson: "There is an interesting mix. With rf devices, there is perhaps less design familiarity and individuals and companies like to see a complete known good layout of the device. So reference examples can give people a

head start if they don't have that expertise. We get others who will take our hardware and our hardware design review and do their own thing, not referring to our bill of materials or design."

However, it is the breadth of applications for Bluetooth Low Energy that makes reference designs a useful tool. "When it was simply Bluetooth, and people were designing Bluetooth headsets, they would recruit and develop the expertise to build the rf system. Now, you can use this for just about anything. You get companies whose speciality might be in software for cycling performance, for example, that want to build some sensors. They would definitely want hardware as close to turnkey as possible. So, because the market has become a lot broader and more people are willing to approach the technology, reference designs are getting more valuable and more important."

The strategy for developing reference designs can also vary

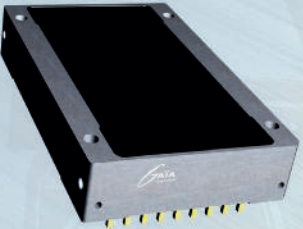


The Nike Hyperdunk+ basketball shoes use CSR's 1010 chip to measure and transmit performance details to a smart phone

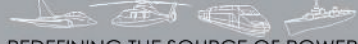


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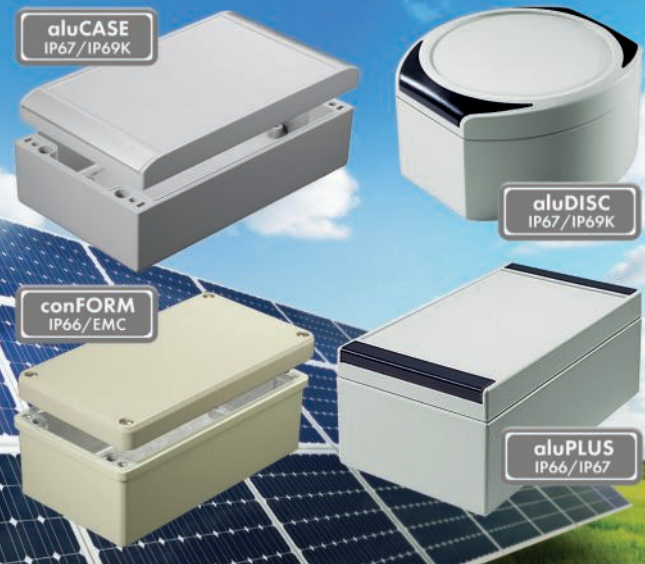
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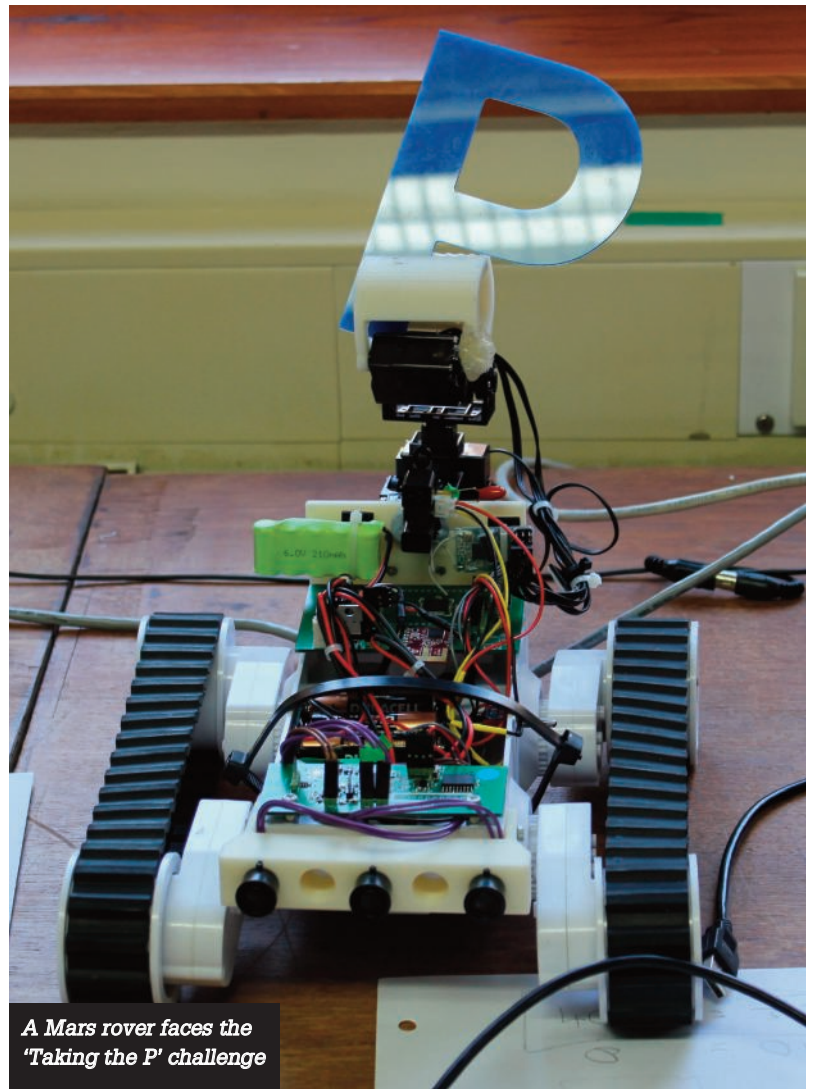
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Degrees rewarded by rover

The plight of the humble technician is not one often considered. Yet technicians can play an important role in giving tomorrow's electronics engineers practical skills. **Tim Fryer** reports

“These days, the courses they teach at universities are very standard and are very mathematically based – if they can make a mathematical equation out of it, they will.” That is the view of Stephen Gould, an electronic technician at the University of Reading. Gould is also on the shortlist for the IET's 2013 Technician Award by virtue of the work he has done to bring practical skills and student interest into some of the courses in the University's School of Systems Engineering.

Most particularly, Gould has led the Cybernetics Challenge, which gives students an opportunity to 'land' a Mars rover on the surface of a virtual (red) planet and conduct some tasks. There are two principal objectives to the work he is doing, the first being to meet the demands of market forces. "Things are changing in the academic market. Students are paying £9000 a year for their courses and they are looking more critically at this, asking what they are getting for their money. We try to give them practical skills, practical applications.



A Mars rover faces the 'Taking the P' challenge

And employers love it, because we're producing people who have proven academic ability – they have a degree – but also those who know how to work in teams, how to solve problems. And, these days, it is all about employability."

Gould's other focus is to highlight the value of technicians themselves and recognise the impact they can have. "I was taken on as an electronics technician which at the start was really facilitating the lab practicals – just to make sure they happened," he explained. "What has happened is that I am now also involved in content and improving its quality. Still, the academics decide what to teach within it, but

technicians have those practical skills that can make it a better experience for the student and therefore improve the learning opportunity."

Following a varied career, Gould has a unique perspective on undergraduate teaching, having recently been an employer, a student and on the university staff and therefore having an insight into the requirements and responsibilities of all of them.

He came to the University in 2006 to study a BEng in Electronic Engineering and Cybernetics and was offered the electronics technician role in 2007. Despite the problems of studying while doing a full time job, and gearing his mind to doing some

of the more complex mathematics that had remain dormant since his schooling more than 40 years previously, he emerged with a first class honours in 2011.

"I was definitely the oldest mature student and it is a different experience because I felt that I wanted to improve myself, I treated it like a job – the students here are after a different experience," he admitted.

This late arrival to higher education followed a career that started off (briefly) in accounting and went on to cover sales and senior management roles in the computing industry, including the pioneering days of teletext, and concluded as chief operating officer for Pacer Cats, the organisation behind online ticketing business Ticketmaster.

However, the company was sold, leaving Gould to look at what to do for the next step in his career. "At that

"I was definitely the oldest mature student and it is a different experience because I felt that I wanted to improve myself"

Stephen Gould



stage, I was a bit stuck as I had lost my technical skills. Getting a job as a managing director in that sort of area is quite difficult when you are 60 odd," Gould admitted. "So I thought why not look at the other side. Rather than work for a company motivated by profit, why not go into the public arena and be motivated by quality? It's a different emphasis; partly about doing something I really wanted to – learn about electronics and how it really works – and then see what happened at the end of it."

The degree helped shape Gould's role as a technician. "I had just been through the process, so I could see and judge what was being delivered to me. It all came together at the right time, the director of teaching and learning was amenable

to a change of emphasis. We redesigned one of the modules and called it the Cybernetics Challenge. We give people a rover – a controller board with a Microchip peripheral interface controller – and spoof it up. We say we are the Reading University Space Agency and they have got the chance to put their rover on a rocket."

Gould believes initiatives such as this can play an important part in providing industry with the sort of graduates it needs, as well as providing students with the sort of value for which they are now looking from their degree providers.

However, Gould believes the school curriculum is helping neither universities nor the electronics industry. "The de-emphasis on electronic engineering at schools these days means that students are coming less well prepared. The first year is really to get everyone up to the same standard, let people catch up and then really start the degree proper in the second year."

The winners of the IET's Apprentice and Technician of the Year Awards will be announced on 20 November 2013.

Rules of the challenge say that control of the rover on competition day must be done remotely

Support goes back to the Future

Differentiating between distributors is not always easy. If they can supply what you want, when you want it and at a good price, then that is all that some engineers would ask for. However, others may rely on their distributors for technical support and so the level of this support becomes important.

Future Electronics has taken the support model a step further with its System Design Centers (SDC), which it describes as a response to the challenges arising from new technologies and reduced numbers of employees in development departments. The SDCs are intended to fill in the gaps and allow customers to concentrate on their strategic tasks and core competences.

Vertical expertise in areas such as power or wireless technologies helps to enhance the attractiveness of the Future Electronics offering, particularly as far as redesigns are concerned. Design services can take the form of full or partial system design, and in effect the team of the distributor can be considered as an overflow resource for customers. This resource provides specific expertise and design manpower to speed customers time to market. The team offers skillsets in four core areas: mcus; power; HMI; and wireless technology. Additionally, the team of more than 40 people can do software coding, general analogue design, pcb layout and general digital circuit design. All Future Electronics employees are an integrated team using the same CAD system, project management system and processes across the world. While the customer is not aware of where a design is done, there is always a local project manager. And, as part of the programme, Future has invested in prototype pcb etching and manufacturing facilities.

• To see the full version of this article, which describes how SDCs helped access control company Paxton with its in house development work, go to www.newelectronics.co.uk and enter 57038 in the search box.



Capacitors

AVX adds two new high-temp/harsh environment MLCC series to its SpiCalci SPICE modelling software

SpiCalci 8.0 now features SXP- and SMX-style MLCCs rated for up to 200°C

AVX Corporation, a leading manufacturer of passive components and interconnect solutions, has updated its advanced SpiCalci 8.0 SPICE modelling software with the addition of two new high temperature multilayer ceramic capacitor series for power electronics employed in harsh environment applications such as down-hole oil drilling. Now featuring the SMX-style stacked, switch mode power supply (SMPS) MLCCs and SXP-style encapsulated, radial-leaded MLCCs – both of which are rated for up to 200°C and exhibit low ESR, ESL, and DC leakage in addition to excellent high frequency performance – SpiCalci 8.0 helps design engineers validate circuits before they are built by allowing them to simulate frequency performance plots and other data for specific AVX components.

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Connectors

Harwin adds new Datamate options for extra design flexibility

Vertical SIL connectors and extra security for extra-small bore types now available

Harwin, the leading hi-rel connector and SMT board hardware manufacturer, has increased the flexibility of its industry-recognised 2mm pitch Datamate hi-rel connector family with new versions. The company now offers its single-in-line, surface mount version in vertical configuration, while the recently-announced extra-small bore product is now available with jack screws for extra mating security. The vertical SIL Datamate connectors will suit any application where PCB space is at a premium. Devices come with three mating options - friction latch, locking latch or without latches. Harwin launched its 28-32 AWG extra small bore contact last year targeting avionics, aerospace, industrial, and robotic applications. The addition of jack screws will ensure contact is maintained even in environments with are subject to severe shock and vibration.

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Semiconductors

GaN Systems and Arkansas Power Electronics International awarded \$2 million by US Department of Energy to develop new transportation technologies

Team to design power-saving gallium nitride and silicon carbide semiconductors for new generation vehicles

GaN Systems Inc, a leading developer of gallium nitride power switching semiconductors, has partnered with Arkansas Power Electronics International (APEI) in a successful bid for funding from the \$45M US DoE programme aimed at developing new vehicle technologies to improve fuel efficiency and reduce transportation costs. The APEI-led team, also including Toyota Motor Engineering and Manufacturing North America Inc, the University of Arkansas National Center for Reliable Electric Power Transmission and the US National Renewable Energy Laboratory, has been awarded \$2 Million as one of the 38 different projects the DoE is funding across the US.

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Optoelectronics

OMC invests in backlight capability to make 'brand identity' affordable for low and mid volume display applications

Profiled LED backlight technology minimizes set up costs

OMC, the pioneer in optoelectronics - LED lighting, backlighting and industrial fibre optic transmission components – has announced that it has invested in new equipment at its Cornwall manufacturing centre to support an increased demand for its Profiled LED backlighting technology. Profiled backlights make it financially viable for designers requiring displays for mid and low volume applications to be able to specify a full-custom display – both in colour and shape – as set up charges are minimal and MOQs are very low.

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Power Semiconductors

New PFM DC/DC Converter from Advanced Power Electronics Corp. saves space and cost

Wide input voltage; high output voltage

Advanced Power Electronics Corp. (USA), a leading Taiwanese manufacturer of MOS power semiconductors and ICs for DC-DC power conversion applications, has announced the APE1910-HF-3, a Pulse Frequency Modulation (PFM) DC/DC converter with a low quiescent current of around 30µA and shutdown current less than 1uA.

Available in a small RoHS/REACH-compliant halogen-free SOT-23-5 package, the APE1910-HF-3 features a wide input voltage range from 1.2V to 12V. It features a switching current limit (typ) of 350mA, a high output voltage of up to 34V. Using a PFM design, the product provides high efficiency across a broad range of load.

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Reference Design

Power Integrations Announces New Reference Design for Efficient PAR38 LED Spotlight

DER-350 achieves excellent dimming performance for all TRIAC dimmer types

Power Integrations (Nasdaq: POWI), the leader in high-efficiency, high-reliability LED driver ICs, today announced a reference design for a dimmable PAR38 spotlight, developed in collaboration with Cree, Inc. (Nasdaq: CREE), a leading LED lighting company. The new reference design, described in DER-350, uses Power Integrations' new LYT4317E, a member of the company's LYTswitchTM-4 family of single-stage drivers, along with Cree's MT-G2 EasyWhite® LEDs. Power Integrations (Nasdaq: POWI), the leader in high-efficiency, high-reliability LED driver ICs, today announced a reference design for a dimmable PAR38 spotlight, developed in collaboration with Cree, Inc. (Nasdaq: CREE), a leading LED lighting company. The new reference design, described in DER-350, uses Power Integrations' new LYT4317E, a member of the company's LYTswitchTM-4 family of single-stage drivers, along with Cree's MT-G2 EasyWhite® LEDs.

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Semiconductors

Lattice Slashes Cost, Speeds Development of Mobile Devices with New Plug-In-&-Go USB iCEstick FPGA Evaluation Kit

On-board hardware supported by design software and reference designs accelerates realization of infrared, sensor applications, and more using low-cost iCE40 FPGAs

Lattice Semiconductor Corporation (NASDAQ: LSCC) today announced its iCEstick Evaluation Kit, an easy-to-use USB thumb drive form factor development board that allows engineers and system architects to rapidly evaluate and develop mobile solutions based on the company's iCE40™ mobileFPGA™ family, the world's first and only FPGAs built to address the mobile devices market. The kit speeds solution development by including, along with the FPGA, hardware features and reference designs targeting infrared and sensor functions for smartphones, tablets, gaming devices and a host of other applications that have demanding requirements for low-cost, low-power and fast-time-to-market.

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System-to-silicon IC design consultancy

Sondrel sees significant interest and uptake of FinFET technology

System-to-silicon IC design consultancy invests to meet new challenges

Sondrel, one of the world's leading system-to-silicon IC design consultancies, believes that the increasing use of FinFET technology will cause new challenges for IC designers looking to benefit from the scaling benefits the new structures offer.

Explains Kevin Steptoe, VP Engineering: "At the latest Design Automation Conference in Texas, much of the talk on the show floor concerned FinFETs. Similarly, we are seeing our customers – who include the largest names in the consumer, computer and graphics industries – already moving to such multi-gate or tri-gate technologies to benefit from the size reduction, increased integration and higher performance offered by these new structures. This is not as straightforward as moving from one process node to another. Sub 20nm requires users to learn new tools; it's not simply a matter of shrinking feature sizes and using standard cell placement techniques."

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