T H E E L E C T R O N

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AUTO ELECTRONICS

Auto Electronics is now in its second year as an integral part of *The Advanced Engineering Show*, forming a natural extension to *Automotive Engineering 2014*, the other supporting exhibitions being *Aero Engineering 2014, Composites Engineering 2014* and *Performance Metals Engineering 2014.* The show was held at The National Exhibition Centre, Birmingham, on 11th and 12th November.

The combined *Automotive Engineering* and *Auto Electronics* exhibition featured around 200 exhibitors as well as two Automotive Feature Areas, an Enabling the Future Feature Area, a Low Carbon Vehicle Technology Feature Area, and two Open Forums.

The Open Conference Programme for *The Advanced Engineering Show* featured over 240 speakers, with presentations being hosted over six integrated show floor auditoriums. Presentations in the electronics field included:

'MISRA-C: 2012 – Cure or Curse?' by Christopher Hills, Chief Technical Officer for Phaedrus Systems

'Assuring Performance Quality, Reliability and Security of In-Vehicle Ethernet Networks' by Thomas Schultze, Business Development Manager for Automotive Spirent Communications

'Printed Electronics: Materials, Processes and applications', hosted by The Knowledge Transfer Network and presented in two parts:

(a) 'Plastic Electronics 101: printable, flexible, smart – The Technology of the Future' by Dan Rogers, Head of Digital Publishing and *Plastic Electronics* journal

(b) 'Printable Electronics – It's the Future' by Mark Beckwith, Sales Manager Integrated Electronics for The Centre for Process Innovation

'Developmental Analysis, Testing and Evaluation', hosted by the Engineering and Integrity Society, also in two parts:

(a) 'Vehicle Data Collection Overview' by Geoff Rowlands, Senior Engineer for MIRA

(b) ‘Basic Fatigue Analysis from Measurements and FEA’ by Robert Cawte, Principal Applications Engineer for HBM

‘Controlling the Next Generation Hybrid Vehicles’ by Alisdair Bowie, HEV Control Engineer for MIRA

‘MEMS Scanning Mirrors for Head Up Displays in the Automotive Sector’ by Jack Bennett, Sales Engineer for Hamamatsu Photonics UK Limited.

‘Innovative Adhesives for Display Applications’ by Dr. Daniel Lenssen, Product Manager for DELO Industrial Adhesives

‘Code Rework after V and V reduced by 50 per cent: KPIT Cummins’ by Jason Masters, Global Product Manager, PRQA.

‘Intelligent Energy Fuel Cells in Automotive Applications’ by Adam Huckstep, Engineering Director for Motive

‘Future Enablers through Printed Electronics – Flexible Circuit Technologies’ hosted by The Knowledge Transfer Network in two parts:

(a) ‘Additive Manufacture of Flexible Printed Circuits’ by Steve Thomas, Product Engineering Director for CIT Technology

(b) ‘Neltex® - Shaping the Future of Fabric-based Circuit Technology’ by Patrick Ferguson, Managing Director of NEL Technologies

‘Conformance Test of eCall and ERA/Glonass Modules’ by Reiner Goetz, Product Manager – Mobile Radio Testers for Rohde and Schwartz GmbH and Co KG

‘Active Battery balancing for Multi-cell Battery Packs’ by Peter James, Director and Technical Specialist for Lyra Electronics

‘Printed Electronics: Materials, Processes and Applications’ hosted by The Knowledge Transfer Network in two parts:

(a) ‘Plastic Electronics 101: Current Trends, Future Opportunities’ by Dan Rogers

(b) ‘Market Development for Flexible Electronics’ by Guillaume Fichet, Principal Engineer for Plastic Logic

‘Electronic Aerodynamic Systems for Hybrid Applications’ by Rob Marchant, Managing Director of Marchant Cain Design

‘STRIVE (Simulation Tools for Rapid Innovation in Vehicle Engineering) – an AMSCI funded Project’ by Mark Harding, Manufacturing Project Leader for BY6xx Programmes, and Senga Shufflebotham, Technical Project Manager for Bentley Motors Limited

‘When and where to use Printed Electronics’ by Neil Chilton, Technical Director for Printed Electronics Limited

In this issue of *The Electron* some of the key developments in the field of automotive electronics are presented, with particular reference to the Auto Electronics exhibition and conference.

ACHIEVING ISO26262 COMPLIANCE WITH QA.C AND QA.C++

ISO26262 is an automotive standard that places requirements on the quality of software for which tools such as QA.C and QA.C++ are ideally positioned to enforce. With the highest adoption in the industry, and a strong heritage in safety-critical applications, QA.C and QA.C++ have been certified as being ‘fit for purpose’ as tools for use by development teams seeking to achieve ISO26262.

At *The Auto Electronics Show*, PRQA Programming Research Limited presented their case for using QA.C and QA.C++ as part of the certification process, with the accompanying case study from KPIT Cummins serving to illustrate.

In their introduction PRQA state:

‘Electronic equipment is increasingly being used in safety critical environments, and the software used in these products is becoming more and more complex. Exhaustive testing to ensure there is no situation in which a failure could occur is rarely possible, and therefore systems must be designed in such a way as to prevent failure or ensure controlled behaviour if failures arise.

The introduction of standards has been an important factor in ensuring the development of robust software in safety critical applications. Coding standards such as MISRA, which mandate the use of a specific subset of a programming language, have been a major factor in the improvement of software quality. More recently the introduction of ISO26262 has mandated the use of better development processes, including the use of coding standards, to encourage further gains in software quality.’

ISO26262 is introduced as an adaptation of the IEC61508 functional safety standard for electronic/electrical/programmable electronic safety-related systems that focuses on the specific needs of electrical and/or electronic systems that are installed in series-production passenger cars. It therefore applies to all activities within the lifecycle of these safety-related systems.

Examples of systems for which the standard was developed include driver assistance, propulsion and vehicle dynamics control as well as active and passive safety systems.

As the complexity of a system increases the risk of systematic failures and random hardware failures increases. The standard therefore includes guidance to help developers to mitigate these risks.

A system to which ISO26262 is applicable may have different levels of user risk or safety requirements. ISO26262 therefore introduces four Safety Integrity Levels that specify the safety measures that are required for a given system. These ASILs (A to D) thus allow different methods to be applied according to the ASIL of the system at a functional level.

PRQA draw attention particularly to Part 6 of ISO26262, which specifically addresses the subject of software development and places requirements on the initiation of software development, software architectural design, and software unit design and implementation. It is for this purpose that QA.C with MISRA C and QA.C++ with MISRA C++ have been developed.

PRQA pioneered coding standard inspection and the two static analysis tools QA.C and QA.C++ are described as 'two of the most comprehensive parsers available today, providing detailed information and accurately enforcing coding standards.'

PRQA add:

'QA.C can be configured to enforce compliance with many coding standards, including MISRA-C:2004 and MISRA-C:2012. Likewise QA.C++ can be configured to enforce compliance with many coding standards, including MISRA-C++:2008. Both tools can also be used for compliance checking in safety-related systems.'

Part 6 of ISO26262 also addresses product development at the software level and incorporates several tables that define the methods that have to be considered. QA.C with MISRA-C and QA.C++ with MISRA-C++ can also be used to ensure compliance with these requirements.

In their guidance PRQA examine topics to be covered by modelling and coding guidelines, principles for software architectural design, design principles for software unit design and implementation, and methods for the verification of software unit design and implementation.

In their summary they state:

'QA.C with the MISRA-C Compliance Module and QA.C++ with the MISRA-C++ Extended Compliance Module have been certified as "fit for purpose" for achieving compliance with ISO26262. The time and cost of meeting many of the standard's requirements associated with development at the software level can be reduced by using these tools. The long history of widespread use of QA.C and QA.C++ in automotive development demonstrates its suitability for use within this industry. QA.C and QA.C++ with MISRA are highly effective tools for any company that needs to achieve ISO26262 compliance for its products.'

About PRQA

Established in 1985, PRQA is recognised throughout the industry as a pioneer in static analysis, championing automated coding inspection and defect detection, delivering its expertise through industry-leading software inspection and standards enforcement technology. PRQA's industry-leading tools, QA.C, QA.C++ and QA Verify offer the closest possible examination of C and C++ code. All contain powerful proprietary parsing engines combined with deep accurate dataflow, which deliver high fidelity language analysis and comprehension. They identify problems caused by language usage that is dangerous, over-complex, non-portable or difficult to maintain.

PRQA's Regional Sales Manager, Mike Ferioli, may be contacted at PRQA Programming Research Limited, Ashley Park House, 42-50 Hersham Road, Walton-on-Thames, Surrey KT12 1RZ. Telephone: 01932 888 080. Email: info@programmingresearch.com

CASE STUDY: KPIT TECHNOLOGIES

In his presentation (see papers) Jason Masters, Global Product Manager for PRQA, illustrated the benefits of defect prevention with reference to the achievements of KPIT Technologies, a company with headquarters in India, sites in 16 countries and a revenue of $444 million. The Automotive and Engineering business unit specialises in developing systems for Tier 1 OEMs and the accompanying supply chain that covers chassis and safety systems, including Air Suspension, Anti-lock Braking Systems, Adaptive Cruise Control, Roll Stability Control and Power Steering.

KPIT began using QA.C some ten years ago in response to customers mandating MISRA compliant software. In many instances the customer's acceptance criteria specifically required the analysis from QA.C to evidence the fact that the developed code adhered to the MISRA coding standard.

Initially KPIT Technologies' V and V (QA) team performed this analysis at the end of the development phase, essentially 'compliance testing' as part of the final product inspection.

MISRA violations, however, needed to be rectified before the project was handed over to the client, and the retrospective work proved to be both difficult and time-consuming.

PRQA state:

'The original developers needed time to re-familiarise themselves with their code, and frequently they had been reassigned to the next project and had to be moved back to complete the rework. The alternative, using new developers, further exacerbated the problem, and significantly increased the risk of introducing new defects.'

Ten years ago a typical automotive contained around a million Lines of Code (LoC). Today the figure is nearer 100 million.

Samir Kulkarni, Head of Productivity and Functional Excellence for KPIT Technologies, is quoted as follows:

"We quickly realised how good QA.C was at identifying coding issues, and that the automation and accuracy of the tool reduced our delivery overhead significantly. We also saw the huge potential for QA.C to drive further productivity improvements, but only if this analysis was fully integrated into our development process and not just used during later stages of verification and the resulting rework."

The critical change came when development teams began using QA.C at the start of the coding phase.

PRQA state:

'The teams were performing the analysis on their desktops and checking-in clean code. The transition to the V and V team at the end of the coding phase was much less factious, as the developers had stepped up to take responsibility for the quality of their code, not leaving this to the V and V team to "police" later in the process.'

Mr. Kulkarni is further quoted:

"Projects which adopted this approach were much more predictable. They consistently delivered high quality code on schedule and to budget. Only later did we realise the degree to which development and V and V activities had become transactional, siloed and confrontational. The confidence of our customer facing business teams in our ability to deliver and meet our commitments increased significantly."

By 2011 KPIT Technologies were performing nightly builds (using a CruiseControl environment) with QA.C fully integrated into the process, automatically delivering analysis on a daily basis. The summary metrics then provided the team leaders with 'superb visibility' of the overall health of each project. Trend analysis then provided powerful indicators to help predict whether a project will meet its quality goals and if it is likely to be completed on time.

KPIT now categorises the severity of all types of defects (non-compliances to the coding standard) and sets compliance thresholds. There is zero tolerance on level 4 and above, which covers MISRA and serious defects.

Mr. Kulkarni says:

"Our objective is now to generate high quality code right from the start of any project. QA.C provides our developers with immediate feed back and they now fix most defects as they are injected. Consequently our code rework after V and V has been reduced by a staggering 50 per cent. This not only saves us money, but has also significantly improved our delivery times."

Looking ahead

Having demonstrated the potential for QA.C to improve software quality and improve project duration, KPIT is now looking to extract further value from PRQA's tools first of all by making greater use of the data generated, and secondly by extending and accelerating the adoption of Continuous Code Inspections and QA.C to other safety critical markets such as medical, where quality remains of paramount importance.

PRQA state:

'QA.C generates a wide range and large volumes of very valuable data. KPIT Technologies continues to analyse this data to identify and better understand the key metrics and other parameters which are strongly predictive, for example, those which anticipate the quality of deployed software in the field. The initial analysis has already proved fruitful, identifying the coding rules which are most frequently violated by developers and feeding this information back into their engineer training programs, thereby preventing these violations being introduced in future projects.'

Contact details as above.

IN-CAR SENSORS TO DETECT DRIVER FATIGUE

According to the safety Forum, fatigue related car accidents account for 8.3 per cent of all vehicle crashes in Europe. This figure accounts for almost 100,000 crashes, 7000 fatalities and 125,000 injuries in the EU every year.

In order to help reduce these figures The Harken Project, with the help of EU FP7 funding, is now providing an innovative and highly effective method of monitoring driver fatigue and providing potentially life-saving alerts.

The system uses a series of unobtrusive sensors in the seat and seat belt to keep track of heart rates and breathing activity. Anomalies such as the onset of sleep then trigger an alert.

The Harken System also has the advantage of being able to cancel out ambient noise, such as vibration and body movements, making it highly sensitive and fast-acting.

In a related development engineers at Ford are developing a car that can measure body temperature using infra-red light, so monitoring the health of a driver whilst driving. Should a driver fall asleep or become ill then the system can take over.

Ford has tested biometric sensors that use body temperature to determine if a driver is having a seizure so that the car can then steer itself and then park itself safely.

In India Ford is also testing a new car ambulance fitted with medical sensors that can measure heart rates and allow doctors to examine patients remotely.

Further information on The Harken Project may be obtained from Pera Technology, Nottingham Road, Melton Mowbray, Leicestershire LE13 0PB. Telephone: 01664 501 201. Email: leap@peratechnology.com

SENSORS TO DETECT LEAKS IN REFRIGERATED TRANSPORT

The European haulage industry is under considerable pressure to reduce fuel consumption and environmental pollution as fuel costs continue to rise, and the refrigerated transport sector is particularly under pressure as many refrigerated products are low margin for supermarkets, making it difficult for increased costs to be passed on. In addition, refrigerated vehicles need to run compressors and chillers, which increase fuel consumption dramatically.

In order to address the problem LeakDetect has developed a new analytical sensor system that can detect the very smallest of refrigerant leaks.

The system uses surface acoustic wave sensors and an innovative chemical mass loading technology to affect the resonant frequency of the device. The electronics interrogate the changes and provide a means of detecting slow leakages in the 1ppm range.

A network of sensors can be mounted on the refrigeration plant in strategic locations.

Pera Technology led the electronics design and development of the interrogation and visual display unit, including schematic design, PCB layout, and development of code, firmware and software to process signals via a co-developed algorithm so as to produce a visual output of the leak.

This was brought together in a hand-held analyser providing advanced data logging and display. A truck-mounted system was also created.

Benefits of the system include:

- Maintenance of the refrigerant charge at its optimum resulting in a 5 per cent reduction in fuel consumption.
- Significant reduction in combustion emissions.
- Significant reduction and control of leaked refrigerants, particularly harmful CFCs that affect global warming.
- Greatly reduced probability of goods spoilage as the temperature differential is maintained through monitoring of the refrigerant.

Contact details as above.

SIMULATION TOOLS FOR RAPID INNOVATION IN VEHICLE ENGINEERING

Simulation Tools for Rapid Innovation in Vehicle Engineering (STRIVE) is an Advanced Manufacturing Supply Chain Initiative (AMSCI) funded project that aims to create a new digital supply chain for the automotive sector.

It is bringing together the latest state-of-the-art virtual engineering technologies to improve the design for manufacture of new vehicles.

STRIVE will develop an integrated solution of high fidelity simulation, immersive virtual prototypes and processes for evaluation.

The R and D programme, led by The Northwest Automotive Alliance, will combine next-generation technologies provided by Optis SAS, Icona Solutions and DNA Agile Group, along with technical integration and research expertise through the University of Liverpool's Virtual Engineering Centre.

Collectively they will work with Bentley Motors in the development and engineering design of new models.

Further information may be obtained from Martina Rodrigues, Project Manager, STRIVE, Suite B313 3rd Floor, 23 Goodlass Road, Speke, Liverpool L24 9HJ. Telephone: 0151 728 3320. Email: info@striveproject.org.uk

DELPHI TO PRODUCE VEHICLE-TO-VEHICLE COMMUNICATION IN 2016

Delphi Automotive has announced that it is to introduce vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication technology in 2016 that will advance driver alerts so as to extend the range of existing advanced driver assistance systems (ADAS) functionality.

Delphi already provides vision and radar systems that warn drivers of a potential accident risk around the vehicle or in its path. Delphi's V2V technology reads radio signals sent from cars that have already detected a potential problem and sends a response to other vehicles in the vicinity.

IHS Automotive Supplier Business Analysis, Issue 8, October 2014, quotes Jeff Owens, Chief Technology Officer for Delphi Automotive as follows:

"The ability to detect and signal to the driver of a danger ahead is a significant leap toward improving driver safety and traffic management. This technology also strategically positions Delphi to help automakers meet potential government regulations related to V2v communications for automated driving."

BACKUP CAMERAS TO BE MANDATORY IN US FROM 2018

The National Highway Traffic Administration (NHTSA) in the US has announced that from May 2018 all new cars and light trucks will be required to have rearview cameras.

The NHTSA has estimated that accidents due to cars and trucks reversing cause around 210 deaths and 15,000 injuries each year, with children under five accounting for 31 per cent of the fatalities.

The estimated cost of the new ruling is around $142 per vehicle, which will translate into around $620 million in production costs.

The new regulations also set minimum coverage lengths and angles for the camera systems, but there is not a specified screen size for viewing images.

The new rules will apply to all vehicles weighing 10,000lb or less.

More information is available from www.safercar.gov

WHITE LIGHT SCANNING SPEEDS UP INSPECTION

Stationary co-ordinate measuring machines (CMMs) have been traditionally used to inspect stamping parts and closures, each part typically taking around two hours to measure. This placed a huge burden on manufacturers that produce some 10 million vehicles a year, without even considering the fact that much of the point-based data generated could be difficult to read and analyse with response times that were often not good enough for requirements during ramp up.

In *Quality Manufacturing Today*, September/October 2014, in the article 'Driving better Solutions for Automotive', Aviel First, Director of Sales, Marketing and Automation Business Development for Hexagon Metrology's White Light product line, explains how the Hexagon Metrology WLS400A white light scanning system has been deployed to revolutionise automotive inspection, cutting inspection times by up to 75 per cent.

The Hexagon Metrology WLS400A uses rapid-exposure digital stereo vision technology to gather highly accurate dimensional data from 2D and 3D images. With three 4.0 megapixel cameras, the white light scanner has a 500mm x 500mm field of view, offering area coverage of 250,000 square millimetres in a single shot. High power blue LED illumination minimises the impact of changes in ambient light. For automotive applications the scanner's ability to measure full surfaces, geometric features and edges is of great importance due to the varied nature of vehicle bodywork.

The author states:

'Where inspection can be automated, manufacturers can make significant time savings. White light scanners lend themselves to robotic use in an industrial environment because of their working distance, and the WLS400A is optimised for integration with common robotic systems to ensure that shop-floor conditions have negligible effects on the results. Data acquisition takes just 20 milliseconds, significantly faster than the seconds required by other white light sensors, giving the WLS400A near immunity to vibrations and line conditions.'

The WLS400A runs on CoreView, a specialist dimensional metrology for white light scanning. When the measurement process is complete the system automatically generates visual reports such as colour maps, as well as the dimensional data. This provides the ease of reference and interpretation that operators frequently require.

With the WLS400A a door unit, for example, with 42 closed features, 427 surface points and 186 edge points defined (door digitising) can now be measured in under 20 minutes instead of the two hours required with the previous CMM system. A typical door measurement takes ten minutes.

The author concludes:

'On average, the time the automotive manufacturer spends on quality inspection has dropped to just a quarter of what it was using traditional methods. Because measurement is closer to the production line, the feedback loop is shorter and corrections can be made in les time. But most startling impact is on the user side, with several plants reporting that the actionable information provided by CoreView makes identifying the root cause of problems significantly faster for staff. The result is an impressively fast return on investment since the implementation of their white light systems, and greater productivity throughout this essential quality control process.'

Further information may be obtained from www.hexagonmetrology.co.uk

LASER TECHNOLOGY REPLACES TACTILE PROBING

Turkish automotive manufacturer Fiat-Tofas has introduced new laser inspection methodologies for the diagnostic measurement of sheet metal components and body-in-white (BIW) assemblies.

Central to the technique is the installation of Nikon Metrology XC65Dx-LS cross scanners and CAMIO multi-sensor metrology software, which are retrofitted on an existing Hexagon double-arm CMM. This has resulted in a halving of inspection times relative to touch probes.

The article 'Body-in-white scanning' in the July/August issue of *Quality Manufacturing Today* explains how the cross scanners have been installed on two Hexagon DEA BRAVO horizontal arm CMMs that are equipped with a continuous wrist CW43 interface. Incorporating three lasers in a cross pattern, the XC65Dx-LS captures full 3D features and surfaces on a single scan. By digitising complex features

from three sides, the cross scanner acquires the complete 3D geometry of the features, driving the accurate extraction of positions and dimensions.

Smart laser intensity adaptation allows any surface, such as those with varying colour or high reflectivity, to be scanned without the use of a matt spray or other user interaction. This is enabled by automatic, real-time adjustment of sensor settings between successive laser stripes and for each individual point along the laser stripe.

The article states:

'During vehicle development the scanners are used instead of touch probes for inspecting individual car panels as well as for complete diagnosis of the BIW, after the car's sheet metal panels have been welded together but before the bonnet, doors and boot lid have been added. In this way, the vehicle's entire sheet metal structure is inspected to very close tolerances, showing the interaction between the panels and allowing parts issues to be separated from process issues. Completed vehicles are also inspected, mainly for gap and flush spacing between different car panels.'

Scanning on the CMM has eliminated the need for dedicated, stand-alone measurement systems and supersedes the use of laser scanners on portable measuring arms, which required two operators to measure both sides of a car, and for operators to be told which features to inspect rather than simply calling up a program from a library to start the cycle. This type of scanning also broadens the application scope of horizontal-arm CMMs allowing better use to be made of the capital investment.

The goal of Fiat-Tofas is now to be able to scan completely all sheet metal panels and parts and create a virtual assembly using the 3D digital copies for geometry evaluation in software. This new geometric verification approach is already revealing part fitting issues and aims to reduce the duration of individual prototype cycles as well as the number of prototype iterations needed to produce different car panels. The 3D measurement data of initial prototype parts will also serve as a reference to analyse dimensional changes during serial production.

Further information may be obtained from Nikon Metrology, Argosy Road, East Midlands Airport, Castle Donongton, Derby DE74 2SA. Telephone: 01332 811 349. Email: sales.nm-uk@nikon.com

IT CHALLENGE FOR FIRST CAR FROM A COMPLETELY NEW CAR BRAND

In 2007 three people in Shanghai embarked on a project that had not taken place for a great number of years, that of building up a new car brand completely from scratch. As part of this project IT specialist Marcus Jansson from SEMCON, an international technology company active in the area of engineering services and product information, was hired to coordinate all matters relating to IT at the start-up company Qoros.

Several of the top management personnel at Qoros had a background in the European automotive industry and had previous experience of working with SEMCON, hence the partnership.

In the publication *Future by Semcon#1*, 2014, the case study is described, beginning as follows:

'After visiting several car mechanics, Marcus Jansson and his colleagues were lost in thought. They had seen how mechanics often had to spend far too much time trying to find the information they needed to fix the car in front of them. They had seen how many digital instruction manuals, despite all the opportunities that modern web functionality offers, mostly featured page after page of text. They had seen that there was an opportunity to create something entirely new.'

Within SEMCON's remit was the responsibility for the development of Qoros' service information system, that is to say the system that provides all of the information that a garage may need to service and repair a car.

This responsibility, SEMCON emphasise, does not begin when the car is finished, and SEMCON's Diagnostics Team Leader, Hakan Andersson, is quoted as follows:

"There is a common misconception that the aftermarket is something you engage in when everything is finished, but if you want to make a car easy to repair or service, you have to think about these aspects when designing the car. We were therefore involved in the development phase to help develop the car's serviceability, in other words that it should be designed in the most service-friendly manner possible."

Whilst there are, in most cases, already routines available to do this, in the Qoros case there were no existing structures and no 'ready answers'. This meant that there was a huge amount of work to be done to ensure that the necessary processes were put in place.

In addition to serviceability, the content of the service information also had to be considered, along with how all of the information should be presented. In this regard, starting from scratch was found to be not necessarily a disadvantage.

Olle Lundgren, Head of Workshop Information, is quoted as follows:

"A great number of older brands are unfortunately locked into systems that were developed a long time ago and really need fundamental change, but this is associated with very large costs and is therefore much more difficult."

As part of the work Mr. Jansson embarked on a study mission to a number of garages in order to determine how mechanics actually looked for information, as well as how it worked practically and how they would, in practice, like it to be both content wise and in terms of presentation.

Following the study mission it was decided to develop a new web portal into which garages could log in and access all of the information that they needed.

Mr. Jansson states:

"For us, publishing digitally was not our primary concern, but we want to make it as easy as possible for individual mechanics to get exactly the information that they need to repair or service the car. For this, modern web functionality is far superior. If you need to replace a fuel filter, just click on the link and get all the information you need. Meanwhile, you have a wealth of information just a click away, and if you want, for example, an overview of the entire fuel system in conjunction with a filter change, you don't have to leaf through a book – you just click on the link. This isn't just a portal, it's a whole world of islands of information which we have put together and created a context from."

The foundation of the digital delivery is the SEMCON cloud service known as 'Lodges', which includes modern and user-friendly interfaces for different devices such as laptops, tablets and smartphones. It is also an automated information distribution channel that continually provides the different units with updated content.

A further feature of the new portal, which is also one of the basic functions of 'Lodges', is its ability to enable the mechanic to obtain car-specific information by inputting the car's chassis number. This is possible because the system knows exactly how the car was built and is able to filter out any information that is not applicable to that particular car. Thus, if a car has manual transmission, there is no reason for the mechanic to have to read about how to repair an automatic.

Commenting on the finished product, Jan Enslow, After Sales Manager for Qoros, is quoted as follows:

"When we saw SEMCON's first suggestion on how to package all the information in an application, there was no question that this was something that everyone in the auto industry would like."

Further information may be obtained from Andrew Head, Business Development Manager, SEMCON, Unit 8 Brook Business Park, Brookhampton Lane, Kineton, Warwickshire CV35 0JA. Telephone: 01926 642 935. Email: Andrew.head@semcon.com

MONITORING AIR POLLUTION FROM BUSES: PIONEERING STUDIES IN BRIGHTON

Brighton, despite its coastal location, regularly experiences air pollution limit breaches of the oxides of nitrogen, the main source of which is widely accepted to be road traffic, with diesel traffic contributing most. Brighton also has the largest number of bus journeys made per head of population in England outside London.

In the article 'Route Cause' by Anthony Smith in *The Ricardo Quarterly Review*, Q3 2014, the pioneering studies being undertaken by The Brighton and Hove Bus Company in order to try and bring this problem under control, are described.

The situation in Brighton was ideal for locally based global engineering consultancy Ricardo to undertake one of the first research studies to assess local emissions at source and in real time, from the vehicles that predominate in pollution 'hot spots'.

Within Brighton North Street was identified as the sole east-west corridor for public transport movements across Brighton and Hove, and also a street where bus movements predominate.

Jon Andersson, Manager of Aftertreatment and Chemical Analyses for Ricardo, states:

"To understand the possible root causes of some of the high emission levels in this vicinity, we approached Brighton and Hove Bus and Coach Company to suggest a research collaboration whereby we measure the real-world emissions of a cross-section of the company's fleet. Brighton's North Street is representative of the challenges faced by so many towns and cities which struggle with poor air quality. If we could understand how vehicles are behaving in this location and identify potential avenues to tackle pollution at source, we might be able to offer a similar research-led approach to many other conurbations across the UK and Europe."

In order to undertake this research Ricardo joined with test equipment specialist HORIBA, suppliers of Portable Emissions Monitoring (PEMS) electronic test equipment.

Whilst recent changes in emissions regulations have mandated the use of Diesel Particulate Filters to reduce Particulate Matter from diesel engines, nitrogen dioxide pollution has remained problematic, particularly as the oxidative catalysis that assists Diesel Particulate Filters helps to generate it.

For the studies Ricardo selected bus route No.7 as it traverses North Street and covers a total of 18 kilometres (9 in each direction), with significant gradients throughout. It was a typical route in which each bus will have operated for considerable time before reaching the 'hot spot' from either direction.

In order to provide a cross-section of the bus fleet three different types of bus were fitted with the HORIBA on-board measurement system, the OBS-2200:

(i) Euro IV fitted with exhaust gas recirculation (EGR) technology

(ii) Euro V fitted with selective catalytic reduction (SCR) aftertreatment

(iii) Euro V SCR-equipped diesel-electric hybrid

The HORIBA OBS-2200 system comprises two state-of-the-art technologies, namely a wet based measurement and an exhaust flow meter. The patented NDIR wet-based measurement system requires no correction for dry to wet measurement and there is no need for a chiller to extract water content. In this way the OBS-2200 avoids complicated correction calculations and reduces power consumption of the system. The exhaust flow meter contains high speed response transducers (also patented by

HORIBA) with eight optional attachments covering exhaust flows ranging from 0-1 cubic metres to 0-65 cubic metres depending on the diameter of the tailpipe.

The technology allows for exact measurements to be made at ambient temperatures between 0 degrees Centigrade and 40 degrees Centigrade at humidity less than 80 per cent and at altitudes of up to 1500 metres. A purpose-built vibration absorbing base plate also makes the system stable over rough road conditions.

As with all newly-developed HORIBA systems, the new OBS technology uses the HORIBA ONE PLATFORM and includes optional interfaces to ECU/OBD data connections with test data logging functions.

The HORIBA OBS-2200 PEMS equipment was installed on the rear seats of the bus adjacent to the engine, and for trials the buses were loaded with a ballast equivalent to a 70 per cent passenger load. For health and safety reasons passengers were not carried on the test runs. Different drivers and driving styles were used so that the effects of these variables could be assessed.

In each case the exhaust system was adapted in the depot prior to tests being carried out on the vehicle. This enabled the research team to ensure that all sensors were incorporated into the system inside the vehicle rather than outside the envelope of the vehicle, as is often the case when PEMS equipment is deployed.

The article states:

'Sampling of carbon monoxide, carbon dioxide, NOx and total hydrocarbons was carried out directly from the exhaust stream, while operating data was extracted from the vehicle's CAN bus to correlate both with the real-time emissions measurements and GPS signals for positioning. The PEMS measurements were performed according to a strict methodology including calibration checks of the equipment before each run.'

Jon Andersson adds:

"By detailed consideration of the type of emissions technologies installed on the vehicle, we could also make estimates of the proportion of NOx emitted as nitrogen dioxide. By correlating the real-time emissions data with the GPS measurements an accurate analysis of the effects of route topology was possible."

Results for the three vehicle types were as expected, with the carbon dioxide and NOx reducing from Euro IV to V and from Euro V to Euro V hybrid. It was, however, also found that certification level is not necessarily a reliable predictor of the lowest comparative emissions performance at a particular location or instant in time.

No obvious influence of driver or driver style was observed, but it was found that carbon dioxide and NOx emissions events were seen to be broadly aligned such that, in general, measures taken to improve fuel economy are also likely to have a positive impact on NOx emissions.

The article concludes:

'Use of the latest PEMS technology naturally requires expert handling and a thorough understanding of vehicle aftertreatment technologies, but applied intelligently it can yield extremely valuable insights into the true emissions of common vehicle types and can help validate potential improvement initiatives. By considering vehicle technology deployment, operational management and local traffic and transport policy in this holistic yet focused and cost-effective manner, efforts to improve local air quality should be both better informed and more effective.'

More information about this project may be obtained from Shaun Howell, Account Manager and Training Co-ordinator, Ricardo UK Limited, Shoreham Technical Centre, Shoreham-by-Sea, West Sussex BN43 5FG. Telephone: 01273 455 611. Email: shaun.howell@ricardo.com

DRIVING THE USER INTERFACE: TRENDS IN AUTOMOTIVE GUIs

Senior Manager for Digia Qt, Sami Makonnen, has published a white paper entitled 'Driving the User Interface: Trends in Automotive GUIs', explaining how whilst motor show concept cars have traditionally attracted attention through outrageous body styling, today's advanced demonstrators place at lest as much emphasis on the electronics that are incorporated into the design.

Many of the latest mid-range cars now have a graphical centre-console for navigation, communication and diagnostics, with the higher range offering connected-car applications delivering Internet access and other value-added applications. This is being driven by car buyers expecting improved user experiences, legislators mandating systems to improve road safety, and manufacturers attempting to connect more closely with customers through electronic value-added services.

The touch screen head unit especially enables input signals such as television, DVD, live video, graphics from advanced driver assistance systems, status information from vehicle sensors, Bluetooth communications, GPS and mapping, and Internet content all to be provided.

All of this makes the user interface design critically important so that drivers can gain the maximum benefit from interacting with the system without suffering from distractions or information overload.

The author states:

'Considerations from designers extend beyond the layout and menu structure to encompass multiple ways of interacting with the system; touch, gesture and voice control will all be necessary, in addition to control using buttons on the console and steering wheel.'

High performance embedded processors originally conceived for mobile applications can be used for in-vehicle infotainment systems as they offer high processing performance, good power efficiency, support for connectivity, multimedia capabilities and support for high-resolution displays. A dedicated graphics core and support for industry standards such as OpenGL® also provide high levels of graphics processing capability.

With higher embedded processing performance available and powerful automotive user-interface concepts already entering the market and providing examples for new designs to improve upon, a need has arisen for better software development platforms.

The author states:

'Developers need a software platform that is easy and intuitive to use, allowing them to work within a graphical environment to build and evaluate complex designs quickly. Fundamentally, this requires tools vendors to deliver application development capabilities - such as layout and design tools – that are optimised for use in design projects.'

The rapid pace of development in the automotive sector also necessitates a flexible development framework, and there is a need to optimise the software development platform so as to minimise hardware dependencies and enable broad cross-platform portability. This can give developers freedom to select the optimum processor for their application and migrate across platforms by simply recompiling for a different operating system as required.

The paper promotes the Qt application framework for the creation of high quality user interfaces:

'Qt includes an intuitive user interface technology called Qt Quick a rich C++ class library with intuitive API and integrated development tools for Graphic User Interface development and internationalisation. The Qt framework also helps reduce development costs and shorten time to market as applications can be demonstrated on a variety of different hardware platforms and and operating systems before any actual hardware is produced.

Qt Quick is well suited for iterative development of dynamic and animated UIs with high performance for multiple platforms. Qt Quick user interface creation is based on a CSS and JavaScript-like language called QML i.e. no C++ skills are needed for creating user interfaces and part of the application logic. UI designers and developers can quickly iterate on the pixel-perfect UI and fine tune UI transitions and animations and see the changes in action immediately.

Qt Quick also eliminates the need for separate prototyping technologies as it can be used to go from concept to design and directly to the end product, which increases productivity and shortens the time from initial concept to end product drastically.

With Qt Quick users also have direct access to native APIs, which provides an easy way to integrate to underlying hardware and platform frameworks. Qt Quick uses hardware acceleration through OpenGL®to deliver maximum performance. This can

also be used for creating extra effects either by using Qt OpenGL APIs or incorporating OpenGL® Shader Effects.'

A complete multimedia framework is also available enabling developers to take advantage of a platform's multimedia capabilities and hardware.

The concept is also designed to provide flexibility to integrate other sensors and sources, such as sonar, intelligent cruise control and rear-view camera. In addition, by leveraging the cross-platform capabilities of the QT framework, the code for this application can be ported to a large number of other hardware platforms and operating systems.

Further information is available from info@qtcompany.com

TOWARDS DRIVERLESS CARS

At *The Electronics Design Show* Dr. Anthony Baxendale, Manager for Future Transport and Research at MIRA, gave a well attended presentation entitled 'Towards Driverless Cars and The Future of Transport'.

This introduced the MIRA Future Transport Technologies Group located near Nuneaton and the ongoing research into the feasibility of driverless cars.

According to Dr. Baxendale the auto industry invests around 5 per cent of its revenues in R and D, making it one of the largest, and electronic systems form a key part of this. Delegates were able to observe 'The Google Car', an autonomous and intelligent vehicle which does not have a steering wheel and has just a foam rubber front. Delegates were also informed that the only accident involving this vehicle had occurred when it was being manually driven.

Dr. Baxendale then described the MIRA Levels of Automation, which ranged from zero through to five, at which point the system does the driving and monitors the environment. Present vehicles are at about Level 2, that is to say multiple systems interacting with each other so as to perform some amount of automation but, crucially, the driver is still in control.

The greatest jump occurs between Level 2 and Level 3, where the driver comes out of the loop and the system drives the car, albeit with an ability to take control back. This is termed 'conditional automation', and only the regulatory framework (The Vienna Convention) currently prevents Level 3 from becoming a reality. Draft changes, however, are due to be ratified in two years, with Level 3 vehicles possibly being sold in three to five years.

The industry is now leading people to work with automation rather than perceiving it as dangerous, and the cooperative driving research at MIRA is demonstrating that it is both possible and feasible to simulate traffic flow, with traffic merging priority at junctions and other road safety factors all integrated into an automated system that is

electronically controlled. All of this is paving the way for such vehicles to be permitted on UK roads in 2015 for trial purposes.

"The DNA of vehicles is changing", explained Dr. Baxendale, with mechanical control giving way to electronic control, and research well under way to try to reduce the 90 per cent of road accidents that are presently the result of human error.

Dr. Baxendale referred delegates to the ISO262 standard and its current review, which mandate zero failures in electronic component design.

He concluded with a reference to the 1.8 million people that are killed every year on the world's roads, and compared it to its equivalent in aviation of 50 jumbo jets a week. He left attendees with the sobering thought that "if airlines lost that they would have no industry".

Dr. Anthony Baxendale joined MIRA in 1991 following a period of five years at The Aircraft Research Association. He is currently responsible for MIRA's future transport strategy and the operational management of the programme to deliver this. The key themes of his programme are low carbon vehicle technologies, intelligent mobility technologies, and autonomous ground vehicle technologies. He has a proven track record of successfully delivering a broad range of transport related research projects for a wide range of government agencies, commercial organisations and internally funded R and D programmes.

MIRA, who also exhibited at *The Automotive Engineering Show*, is a global leader in safety development, with services that range from individual project tests to turnkey multi-vehicle design, development and build projects. Core competencies include vehicle engineering, test engineering, homologation and certification services, intelligent mobility, controls and xEV engineering, functional safety, autonomous vehicle technology and unmanned ground vehicles (TGV), as well as future transport technologies.

Further information about this project may be obtained from Dr. Anthony Baxendale, MIRA Limited, Watling Street, Nuneaton, Warwickshire CV10 0TU. Telephone: 0246 355 000. Email: enquiries@mira.co.uk

INSTITUTION NEWS

The Institution is pleased to report that its AGM was held on Thursday 27th November at Barrowmore Training Centre in Cheshire. The Institution would particularly like to thank the management and staff at Barrowmore for the use of their excellent facilities and kind and welcoming hospitality.

As part of its ongoing commitment to the Arkwright Scholarship Scheme the Institution is pleased to announce that it is to sponsor Niall Woodward of Bolton School as its Arkwright Scholar for 2015. He is the fourth student that the Institution has sponsored under the scheme, joining previous Arkwright Scholars Marek Hilton

of Lancaster, James Boubier from Skipton and Ms. Elaine Macqueen from Strathclyde.

In addition the Institution is pleased to announce the appointment of Ms. Elaine Macqueen to the new post of Student Liaison Officer for the Institution. In this role she will be the first point of contact for students wishing to join or contribute to the Institution, and for general enquiries from students at home and abroad

This concludes The Electron for 2014. We hope that readers have enjoyed the topics, articles and features that have been featured for the four issues of this year, and that they have been useful and informative.

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THE INSTITUTION OF ELECTRONICS WISHES EVERYONE A VERY

MERRY CHRISTMAS AND A HAPPY AND PROSPEROUS NEW YEAR 2015

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