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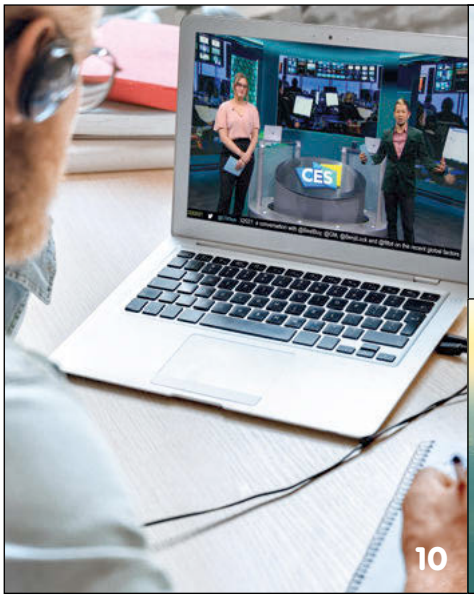

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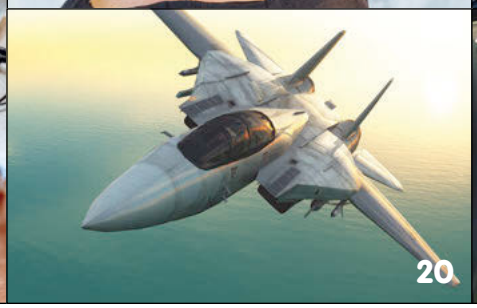
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MISSION STATEMENT

'New Electronics keeps designers and managers abreast of the latest developments in the world's fastest moving industry'

More companies turn to AI

A NEW SURVEY HAS SUGGESTED THAT UK BUSINESSES ARE TURNING TO AI TO BUILD BACK FROM COVID-19

New research, conducted by Fountech Solutions, has shown that a growing number of UK businesses are turning to AI to build back from Covid-19. The survey of 750 decision-makers within UK businesses found that a third had piloted an AI solution for the first time since the onset of the pandemic, and that forty per cent plan to make AI investment a priority for 2021.

The investment is seen as giving their businesses a sustainable advantage in the long-term, and for many it's been a natural response to the Covid-19 pandemic as they look to leverage new solutions to ensure that they not only ride out the current 'storm', but are in a stronger position once a degree of normality returns.

In this issue of New Electronics we interview Beatriz Sanz Saiz, EY's Global Consulting Data & Analytics Leader, about a report from Ernst & Young that looked at technology and how it's being used to accelerate the digital transformation of businesses.

The pandemic has accelerated investment in new technology and today, according to Saiz, the debate is less about investing in new technology but rather how to embed and integrate technology at the core of a business.

The report identified six core 'habits' that it sees as critical to transforming a business through the use of technology, and investment in AI was described as being a critical part of that transformation.

Covid-19 has been a powerful catalyst for AI adoption across all industries as firms look to technologies that can help improve efficiency or create new commercial opportunities.

Fountech found that not only are businesses looking to increase their investment in AI but a sizeable number are planning to hire new talent to deal specifically with AI, while almost half are planning to send staff for AI-related training. External AI experts are also in high demand, with 44% of businesses planning to engage with third parties to help with their AI requirements.

This snapshot of UK business mirrors other research that shows that AI R&D is continuing to grow strongly. AI start-ups are filing more patents and there is now a growing appetite from more established companies to become increasingly active in the AI space.

There can be no doubt that AI will start to play a major role as businesses look to rebuild and grow after the pandemic.

So could 2021 be the year in which AI adoption explodes?

Neil Tyler, Editor (neil.tyler@markallengroup.com)

"Covid-19 has been a powerful catalyst for AI adoption across all industries, as firms of all sizes look to technologies that can help improve efficiency or create new commercial opportunities."

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Editor	Neil Tyler *neil.tyler@markallengroup.com*
Contributing Editors	Chris Edwards, Charlotte Hathway, John Walko *editor@newelectronics.co.uk*
Art Editor	Chris Charles *chris.charles@markallengroup.com*
Illustrator	Phil Holmes
Sales Manager	James Creber *james.creber@markallengroup.com*
Publisher	Peter Ring *peter.ring@markallengroup.com*
Managing Director	Jon Benson *jon.benson@markallengroup.com*
Production Manager	Nicki McKenna *nicki.mckenna@markallengroup.com*

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T: 01322 221144 E: *ne@markallengroup.com*

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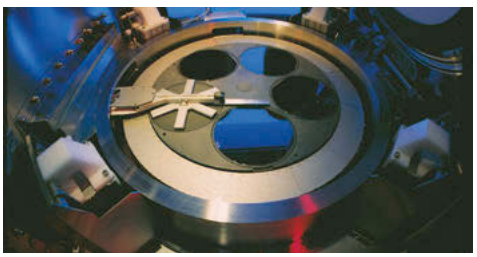
UKRI support for 200mm Gallium Nitride HEMT foundry process

UKRI SUPPORTS THE CSC AND NEWPORT WAFER FAB IN DEVELOPING A 200MM GALLIUM NITRIDE HEMT FOUNDRY PROCESS. **NEIL TYLER** REPORTS

UKRI has announced support for the Compound Semiconductor Centre (CSC) and Newport Wafer Fab (NWF) in developing a 200mm Gallium Nitride HEMT foundry process.

The project is a co-ordinated effort by CSC and NWF to deliver a foundry grade 650V GaN-on-Silicon HEMT process on a 200mm wafer platform. The HEMT fabrication process technology will leverage 30 years of Silicon Power device manufacturing heritage at Newport Wafer Fab, developed under an automotive (IATF 16949) quality accredited volume manufacturing environment. The epitaxial solution will look to leverage IP developed by CSC in partnership with its parent company IQE, on a high volume Aixtron G5 200mm manufacturing platform at its Cardiff, UK facility. CSC recently achieved full ISO9001 accreditation of its internal Quality Management System covering development through to volume scale up. The project is supported by UKRI under the '*Automotive Transformation Fund: moving the UK automotive sector to zero emissions*'.

Commenting Sam Evans, NWFs Director of External affairs, said,"This is an exciting step towards NWFs vision of becoming a major manufacturer of Compound-on-Silicon products. We see the Wide Bandgap Power device market



as an excellent area to address in our plans to expand our current manufacturing footprint of 8,000 wafer starts per week to 14,000, and it's a natural opportunity for us to pursue given our heritage in high power Silicon MOSFET, IGBT and GaN device development manufacturing."

Rob Harper, GaN programme manager at CSC added, "The GaN Power market is estimated to be worth over $700m by 2025 with massive future growth opportunity for EV adoption, and we are collaborating with a global power semiconductor blue-chip to help steer the process roadmap.

"We are initially targeting the EV segment of the market including traction inverters; as the project progresses we hope to roll out custom foundry offerings that address additional market segments including mobile/laptop fast chargers and energy storage inverters."

Accelerating embedded software compliance

LDRA has partnered with PTC to reduce the cost of compliance for critical embedded software developers who are required to adhere to functional safety and security standards.

The integration between the LDRA tool suite and PTC's Windchill RV&S provides the capability to perform bidirectional traceability, standards compliance, and automated software quality analysis and verification throughout the development lifecycle, saving both time and money for developers who need to demonstrate compliance.

Ian Hennell, Operations Director, LDRA said, "Through this partnership, enterprise customers can quickly link the Windchill RV&S artifacts into the software quality and verification workflow."

From a workflow perspective, developers use Windchill RV&S to manage requirements, test cases, and code. The LDRA tool suite links those requirements to the software analysis and verification process to help identify and eliminate software flaws and vulnerabilities.

Developers can use both in-depth static and dynamic code analysis to verify the code, including checking for coding standards compliance such as MISRA and/or CERT compliance, as well as structural coverage analysis. They can also perform automated test case generation and execution on the code within the LDRA tool suite and feed the results of those tests into Windchill RV&S to achieve bidirectional linkage and traceability.

This combined solution automates software analysis and verification and provides bidirectional traceability from requirements to source code, to the analysis and verification results. It also enables rapid impact analysis and regression testing, which shortens the time to response and reduces development and verification costs.

Sequitur Labs partners with STMicroelectronics

A leader in IoT security for connected devices, Sequitur Labs has announced it has joined the STMicroelectronics Partner Program to make Sequitur's EmSPARK Security Suite available for technical and business collaboration between ST and third-party companies.

As a member of ST's network, Sequitur will be able to ensure that ST-powered smart edge devices – and their sensitive data assets – are fully protected.

Sequitur's EmSPARK Security Suite will be able to offer a security framework protecting embedded firmware, keys, and security-critical assets for both ST's customers and thousands of partners building products, solutions, and ecosystems in fields like smart mobility, efficient power and energy management, IoT, and 5G.

Philip Attfield, Co-founder and CEO, Sequitur Labs said, "By joining ST's Partner Program, we can help its network of developers rapidly achieve the required level of security for their connected devices, help design, build, and sustain smarter and more secure products."

EmSPARK enables advanced security functions on the device itself, not through a network connection, and through the device's entire lifecycle. Developers are able to easily build applications using Sequitur's EmSPARK APIs and SDK without having to become experts in cryptography and complex hardware security technologies. It enables silicon hardware security features, secure device provisioning, and API access to essential trust services such as secure storage, firmware updates, and payload verification.

SLAMcore announces new software release

SOFTWARE LOOKS TO ASSIST DEVELOPERS OF ROBOTS AND CONSUMER ELECTRONICS PRODUCTS. **NEIL TYLER** REPORTS

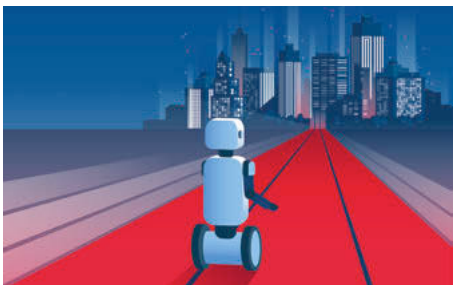
SLAMcore, a specialist in Spatial Intelligence for autonomous location and mapping, has released new software for developers of robots and consumer electronics products.

The release expands SLAMcore's location/mapping capabilities (visual inertial SLAM) for developers of robots/consumer electronics products and helps developers overcome the challenges associated with locating, mapping and perceiving the physical environment around robots and consumer products. SLAMcore software uses stereo cameras, inertial (IMU) and depth sensors to provide real-time location and mapping information.

The company's location and mapping (SLAM) software works on cost-effective sensors and processors and can save developers months in development time.

The new release enables SLAMcore to provide deeper integration between its Spatial Intelligence software and the Robot Operating System code (version 1.0).

Enhanced support for wheel odometry will allow designers to feed additional motion data to the SLAMcore software for even more robust location estimates; while enabling greater customisation, SLAMcore software can now be tailored to perform in a wider range of conditions. The ability to reconfigure SLAM algorithms to match the target environment conditions for a robot significantly improves both robustness and performance.



SLAMcore's software works 'out-of-the-box' with Intel RealSense sensors and x86/Nvidia Jetson compute enabling the faster roll out of prototypes.

The software can be further optimised for specific use-cases, custom hardware and additional sensors for use in a wide range of commercial robotics and consumer electronics products.

Commenting Owen Nicholson, founder and CEO of SLAMcore, said, "Our role is to make it as easy as possible for developers to add robust, high performance SLAM capabilities to their products as quickly and cost effectively as possible. Working closely with ROS and its codebase, as well as delivering support for environment customisation, and supporting new sensors like wheel odometry means that more developers can benefit from integrating our software into autonomous robots and consumer electronics."

NXP launches flexible IoT Cloud Platform

NXP Semiconductors has introduced the EdgeLock 2GO IoT service platform delivering easy, secure deployment and management of IoT devices and services. The IoT security platform is integrated with NXP's Common Criteria (CC) EAL 6+ certified EdgeLock SE050 secure element to protect IoT devices at the edge and securely connect them to one or multiple clouds and service providers.

"EdgeLock 2GO provides a full range of choices and options that optimise the costs around credential and device management, while delivering advanced device security for companies operating in the IoT," said Philippe Dubois, VP and GM of Secure Edge Identification at NXP. "The platform provides a highly flexible approach to IoT security that protects edge devices connecting to services and maintains edge device security throughout its entire lifecycle."

The EdgeLock 2GO platform, combined with NXP's embedded EdgeLock SE050 secure element for advanced key protection and management, delivers end-to-end security–from chip to cloud–based on a certified Trust Anchor.

The EdgeLock SE050 makes it easier to implement advanced security, and the EdgeLock 2GO streamlines secure cloud on-boarding and access to IoT devices from different service providers. It also simplifies application credential management with zero-touch connectivity to public and private clouds, edge computing platforms and infrastructure.

Crypto Quantique secures IoT

Crypto Quantique, a specialist in quantum-driven cybersecurity for the IoT, has made its universal IoT security platform, QuarkLink, available to semiconductor manufacturers and systems integrators.

QuarkLink can be used by companies that use root-of-trust (RoT) solutions of their own, or those sourced from other vendors.

The platform was originally designed to work with Crypto Quantique's own quantum-derived root-of-trust IP, called QDID.

The QuarkLink platform's capabilities have been designed to be far more comprehensive than typical key management services. It is able to handle provisioning, including secure firmware and cryptographic keys, automated secure on-boarding, and security monitoring, including firmware encryption, signing and secure updates over-the-air, and certificate and key renewal and revocation.

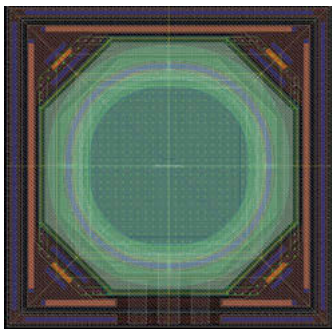
With some RoTs, including QDID, QuarkLink eliminates the need for hardware security modules (HSMs) and key injection, saving cost and time, while increasing security.

QuarkLink can be set up in a few minutes by engineers without specialist IoT security knowledge. End-point devices are then connected to servers through cryptographic APIs, using just a few keystrokes to initiate an automated process capable of on-boarding thousands of devices in seconds to a server platform, or to multiple platforms simultaneously.

QDID generates random, unforgeable cryptographic keys on-demand in silicon by measuring the quantum effects in chips manufactured on standard CMOS processes.

New generation of APD and SPAD devices

X-FAB ANNOUNCES ENHANCEMENTS TO ITS 180NM APD AND SPAD DEVICES. **NEIL TYLER** REPORTS



X-FAB Silicon Foundries, the specialty foundry for analogue/mixed-signal and optoelectronic solutions, has introduced its latest generation of avalanche photodiode (APD) and single-photon avalanche diode (SPAD) devices.

These new APDs and SPADs benefit from innovative architectural modifications, with substantial improvements in performance exhibited compared with the company's earlier devices. Footprint compatibility with the previous generation, however, has been retained which means that a simple and convenient upgrade path is possible, with no additional engineering work being required.

The boost in performance is most noticeable in relation to photon detection probability (PDP). There is a 42% PDP figure for incident light at 405 nm, while further up the spectrum in the near-infrared (NIR) frequencies the improvement is as much as 150%, with a 5% PDP being demonstrated at 850 nm.

An after-pulsing probability of 0.9% has been achieved which represents a 70% reduction compared to the first-generation devices. The dark count rate (DCR) is only 13 counts/s/μm^2. The fill factor (the percentage of these sensors' surface area that is active) which can now be supported has almost doubled – reaching 33%.

X-FAB has also incorporated a trigger diode – which allows precise, real-time on-chip breakdown voltage detection without an external light source.

Active quenching circuitry is included, through which the rate at which the SPAD devices recover can be accelerated, allowing them to be made ready for further light detection. The new SPADs offer better application adaptation due to their size flexibility. First-time-right design is supported by complete device models for the SPAD and APD devices. The behaviour of the new built-in trigger diodes is included in the model.

"Thanks to the combination of elevated PDP and competitive DCR levels, we are presenting the market with APD/SPAD solutions that have impressive signal integrity characteristics, which will directly benefit our customers for applications like computer tomography and fluorescence detection within the medical sector, as well for time-of-flight and LiDAR in industrial and automotive systems," said Detlef Sommer, Business Line Manager for Opto Technologies at X-FAB.

Bill of Materials in minutes

Anglia Components has introduced BOM+, a new feature for Anglia Live which will allow customers to upload a Bill of Materials (BOM) and get a volume quote in a matter of minutes.

According to Anglia it is now possible to cross reference the manufacturer and industry recognised part numbers, a feature that it says is unique to this platform.

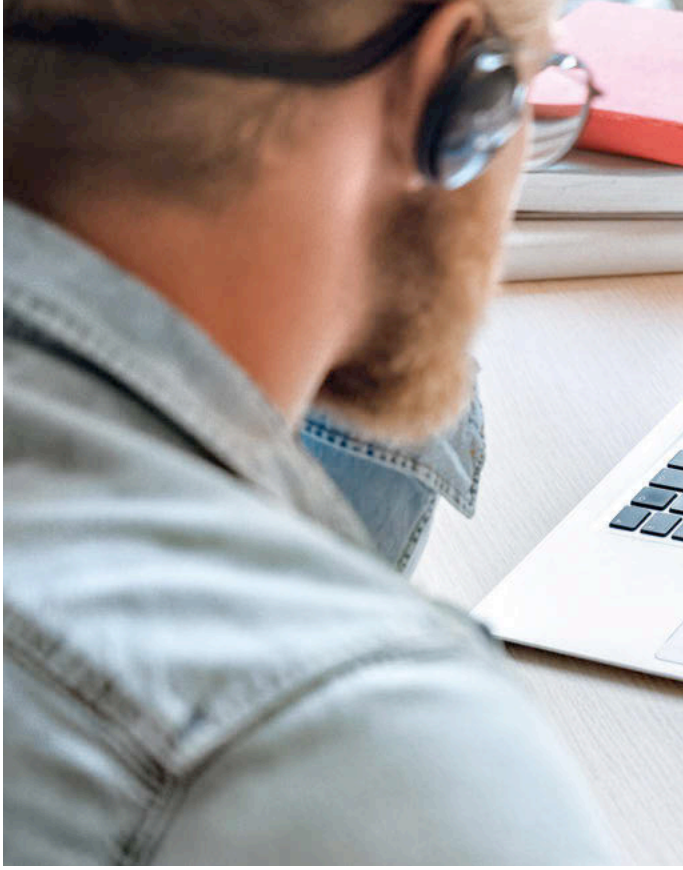
The software supporting BOM+ has been developed in-house and is intended to be easy to use and customer-friendly. There is no template specified so customers can enter data in their own format and no file sorting or adaptation is required. Anglia BOM+ is able to work with Excel and other popular file formats, and accepts data as the customer has entered it, providing an immediate volume quote.

BOM+ is able to price up the quantities specified at the customer's contract price or the appropriate price break, whichever is more economical. It will then flag up opportunities to reduce the unit price by increasing the order quantity on specified line items.

Commenting Steve Rawlins, CEO, Anglia, said, "BOM+ is a world leading product from Anglia. It offers more flexibility and information far quicker than any similar tool in the industry. Customers can now get an instant quote from Anglia that fully reflects the volume that they are sourcing and any discount structure or negotiated pricing they have in place with us.

"BOM+ can accept most popular file formats using the customer's preferred layout. In short, we've cut out the fuss in getting a Bill of Materials fully costed."

CES 2021 – setting the tone for the consumer industry



The first ever all-digital CES took place last month and below we consider some of the key trends, and take a look at some of the technology that was on show. By **Neil Tyler**

Over many decades CES has not only marked the start of a new year, but has helped to set the tone for the consumer industry. Despite the global pandemic the organisers of CES were able to hold the first-ever, all-digital show using technology to connect people across different digital platforms.

Introducing CES 2021, Gary Shaprio, President and CEO, Consumer Technology Association, spoke about technology providing a stabilising force in a world beset by the uncertainties caused by Covid-19 and that it had helped to keep people connected, whether to their friends and family, businesses or schools.

"With no boundaries to innovation," Shapiro said, "we've been able to use technology to bring the consumer ecosystem together to help create what will be a safer, smarter, healthier, more resilient and empowered world."

According to figures from Semiconductor Intelligence, despite having to go digital, CES 2021 reported 1,960 on-line exhibitors and a virtual attendance of almost 70,000 – while both were significantly down on 2020 it was a real achievement for the organisers.

Covid-19 has changed almost everything over the past twelve months and the way we think about transportation, healthcare, education and the way we work has been fundamentally altered.

This year's show highlighted a number of emerging technology trends many of which have been accelerated by the pandemic, such as: e-commerce, telemedicine, streaming video, remote learning, AI & machine learning, natural language processing, cloud computing and remote health monitoring devices.

At the conference, running alongside the show, speakers said that technology companies not only had a role in helping to build back better after the pandemic, but also in lessoning the digital divide which had been highlighted with people having to work from home.

Sales surge

Figures from the Consumer Technology Association (CTA) suggest that US retail sales revenue for the technology industry in 2021 will increase by 4.3% from 2020, reaching a total of $460bn - this includes electronics hardware, software, and services.

In terms of hardware, smartphones are expected to remain the largest category, up 5% to $73 billion in 2021, with 5G smartphone revenues expected to triple over the year.

"We've been able to use technology to bring the consumer ecosystem together to help create what will be a safer, smarter, healthier, more resilient and empowered world."
Gary Shapiro

Interestingly, due to the large numbers of people working and learning from home laptop PCs saw strong growth in 2020.

According to figures from analysts Canalys, shipments within the global PC market were up by 25% in 2020, marking the sector's biggest annual growth since 2010 and was "singlehandedly driven by notebooks and mobile workstations".

Commenting, analyst Rushabh Doshi said, "It is going to be extremely difficult to write off the PC as some of us did a few years ago. PCs are here to stay."

That strong performance in sales of laptop PCs also led to increased demand for ancillary products, according to Corrie Barry, the CEO of Best Buy. "With everyone at home we saw demand for web cams, speakers and microphones grow significantly, as people wanted to have the best experience they could while at home."

Being at home also changed consumer attitudes towards e-commerce, with consumers turning to the web to make purchases of electronic goods in a move many at CES saw as a significant shift to a 'digital first' approach. The disruption seen to the supply chain saw consumer behaviours changing and, as a consequence, businesses found

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themselves having to get better at predicting those changes, which has meant a shift towards using artificial intelligence and embracing more digital technology.

"2021 has been a pivotal moment for the consumer electronics industry," said Michael Miebach, CEO Mastercard. "Consumers will be able to do more from home and that will have massive implications as to how businesses engage with them. We've been able to demonstrate that going online is easy! There may be some issues around safety and data protection, but this is now the direction of travel."

Connected health

Every year connected health and fitness products have a strong presence at CES, and the US market is expected to be worth in excess of $9bn in 2021. Within this category, connected health monitoring devices revenues are expected to grow strongly with more people using this technology to check for Covid-19 symptoms and manage chronic conditions from home.

While the end of the pandemic may be getting closer many frontline health care workers, warehouse operators and people working from home, are still going to need some form of protection.

In response this year's CES saw a large number of new products designed to combat the spread of Covid-19, such as smart face masks, sanitizer dispensers for car consoles and business solutions like autonomous UV robots.

Gaming hardware specialists, Razer, introduced Project Hazel which it described as the "world's smartest mask" – it includes both an active ventilation and a self-sterilization function. It also deployed Razer Voiceamp technology which it said was able to listen to the wearer's voice and then intelligently reproduce it through two speakers, for clearer communication. Project Hazel remains a concept, however, with no word on either pricing or availability.

Above: Project Hazel, the world's 'smartest mask'

A wearable device from BioIntelliSense, the BioButton, also went on display. It has been designed to continuously track a variety of vital signals such as temperature and respiratory rate to monitor a person's health and forms part of a complete Covid-19 screening system that connects to the BioMobile app. Data is sent to the BioCloud, which then looks for subtle physiological changes and delivers a complete report to the user on potential signs of risk.

Importantly, this health data is protected with end-to-end encryption from data capture to secure storage, and uses privacy protocols that comply with US government legislation.

Airpop's Active+ Smart Mask brought Fitbit-style health tracking to the user's breathing and air quality. A sensor, called the Halo, is used to measure breathing rates and monitors the filter installed in the mask, it then delivers the data straight to a mobile app. The app is able to monitor the mask's effectiveness, breaths taken per minute, and the volume of air that has passed through it.

Left: The BioButton can continuously track a variety of vital signals

Going back to basics in terms of monitoring health, the Japanese firm Toto unveiled a lavatory that is able to

check a user's health by using sensors to scan, what was delicately described, as a person's 'key outputs'. According to a company spokesman, "A wealth of wellness data can be collected from faecal matter." Not only that, readings can also be taken from a user's skin, when they come into contact with the seat.

An internet-connected version of the appliance is expected, "in the next several years".

Seriously, this type of technology could have a crucial role to play in the workplace monitoring for signs of Covid-19 and detecting possible outbreaks.

Robotics

CES 2021 saw robots also having an important role in automating processes tied to Covid, such as maintaining social distancing, and serving as home companions and personal assistants.

The Bot Handy 'robot butler' from Samsung garnered a lot of interest. It demonstrated its ability to empty a dishwasher, pick up around the house, pour a glass of wine, as well as independently raise and lower itself based on the height of the items it needed to pick up.

Samsung also unveiled a robot vacuum with a built-in security camera (the JetBot 90 AI +) and the Bot Care robot, which has been designed to act as a personal assistant. It has a tablet-like display for calls and communication and is able to learn from your behaviour.

Likewise, South Korea's Hancom Toki H2 is a companion robot which can serve as a personal assistant. The home robot allows for customised conversations between family members and users, and has been designed to actively engage in daily life based on facial recognition technology and educational content.

In addition, several exhibitors presented robots intended to directly combat the virus.

LG, for example, is developing an autonomous robot that uses UV-C light to disinfect and is intended to be used in hospitality, retail, and business locations, providing a device that can effectively sanitize during the pandemic.

Above: Robots were seen as having an important role in automating processes

"This autonomous UV robot comes at a time when hygiene is of the highest priority for hotel guests, students, and restaurant customers," said vice president Roh Kyu-chan, head of the robot business division in LG's Business Solutions Company.

The robot is able to irradiate touchable surfaces in 15 to 30 minutes, and can disinfect multiple surfaces on a single charge. LG's UV robot will be available in early 2021.

As well as disinfecting rooms using UV lights robots are increasingly being used in hospitals to take patients' temperatures and vital signs as they are admitted.

It does appear that people are now paying more attention to their personal health and wellness as well as to the environment at home and in the workplace. As a result, it's likely that over the coming year more robots will be seen serving in new roles at schools, hospitals, offices, gyms, and on public transportation.

Technology round-up

In terms of consumer goods, the two fastest growing categories in 2021 are expected to be wireless earbuds and gaming consoles – the former is expected to be aided by the increase in video and audio conferencing.

Gaming consoles have benefitted from more people seeking entertainment at home and by the introduction of new gaming systems by Sony and Microsoft in late 2020.

For the past year many more people have been working out of home offices.That is a trend that's not going to go away, and as a result some of the biggest innovations in 2021 are going to be in AI, and the greater use of voice assistants such as Alexa. According to some analysts demand for smart wearables, which provide a direct link to voice assistant providers without having to access your phone, will see very strong growth.

The impact of people staying at home more in 2020 has been reflected in the strong growth of software and streaming services.

Video gaming software and services remain the largest market segments but after the growth seen in 2020, video streaming is now a much more important market segment.

TVs at this year's show continued to get larger and larger, in many cases exceeding the available wall space in many homes. One notable example being Samsung's MicroLED 110 inch television which can display up to four separate screens at once – at its launch in South Korea the cost was put at $150,000, so it's unlikely to be a big seller.

Lenovo introduced its ThinkPad X1 Fold, which it says is the world's first foldable PC. With a 13.3 inch OLED display it folds to half that size and the display can be shown on one screen or two. It has an on-screen keyboard and an optional external keyboard.

Many top auto manufacturers did not participate in this year's show, but both EV and autonomous vehicles remained hot topics, alongside technologies such as cellular vehicle-to-everything (C-V2X) and mobility-as-a-service (MaaS) many of which will be driven by the advancement in 5G.

While this year's CES may have missed some notable names the companies that did participate were able to showcase many new and innovative products.

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MICROCHIP

Embrace digital technologies

Beatrize Sanz Saiz, EY's Global Consulting Data & Analytics Leader, talks to **Neil Tyler** about how companies should look to embrace new technology

According to Ernst & Young's, 'Tech Horizon: Leadership perspectives on technology and transformation' report, which takes a look at new technologies and how they are helping to accelerate business digital transformation, companies leading the field in embracing digital technologies are, putting it simply, able to make more money than their competitors.

The report looks at the key drivers of digital transformation and highlights six key 'habits' exhibited by digital transformation leaders, and suggests that industry laggards could learn from these transformational leaders.

According to Beatriz Sanz Saiz, EY's Global Consulting Data & Analytics Leader, the report shows that, "We have reached a point of no return when it comes to digital transformation. The process has been accelerated by the global pandemic and the debate is no longer about investing in new technology but rather how to embed and integrate technology at the core of your business.

"There are plenty of companies, across different sectors, that are well advanced along this 'transformation journey', and, as a consequence, are generating significant additional value."

Saiz says that the six core 'habits' that are critical when it comes to transforming a business through the use of technology include: "Focusing on customers, first and foremost; accelerating investment in artificial intelligence (AI) to drive growth; driving innovation through embracing ecosystems and partnerships; nurturing talent; accelerating governance plans for emerging technology and, finally, powering innovation by leveraging data and being agile."

According to Saiz, while adopting these habits is critical, it doesn't guarantee financial success, although, "AI has a crucial role in driving growth and revenues and enabling new and different customer experiences."

She points to Tesla as an example of a company that has embraced technology and applied AI to deliver a better customer experience.

"It embedded AI at the core of its business, transforming not only its back office but the entire supply chain. Critically, it became, as a result of that investment, more nimble and able to implement changes quicker."

Debunking some myths

Saiz says that when it comes to investing in AI there are certain 'myths' that have surrounded its application.

"When I talk about 'myths' I refer to ideas such as AI should always be implemented away from business units. In reality, the ultimate value of AI can only be realised when it is placed at the very heart of the business.

"Another is that AI and the IoT should be considered separately. That is certainly not the case. Companies that are capturing the benefits of AI have coupled that capability with the IoT in order to extract greater value.

"And finally, when it comes to data, there's an argument around quantity rather than quality being the goal. Another myth, because only well managed and reliable data will drive more impactful insights," Saiz argues.

Saiz accepts that it will be very expensive for those laggard companies to catch up with those that have embraced AI and other technologies already.

"While it will certainly be more expensive for followers, it will be even more costly if they don't invest in technology," she argues. "Transformation is critical when technology is constantly undermining traditional business models."

According to Saiz, the market is seeing increased merger and acquisition (M&A) activity across all sectors, as companies use it as a means to catch up with sector leaders and acquire the technologies they need in order to compete.

"This trend is being driven by companies looking to catch up or by those looking to become a leading player in their space," she believes. "We are seeing a lot of activity among companies trying to better understand how to embrace emerging technologies."

In terms of sectors, Saiz suggests that all of them are embracing technology.

"We don't see any sector where AI does not apply but there are some benefitting more than others," she concedes.

"Sectors that have to handle large data volumes, for example, banking and insurance, and manufacturing, with the rise of the IoT and Industry 4.0, are investing heavily in technology and AI."

Covid-19 has certainly played a part in accelerating existing trends.

"Health is based on data and the impact of the pandemic has driven increased levels of investment. We are seeing a more active role for technology and AI, in particular. Covid has accelerated plans and we can expect to see huge investments in AI and emerging technologies by health providers over the next 3-5 years."

> "AI has a crucial role in driving growth and revenues and enabling new and different customer experiences."

Technology investment

According to Saiz, any sector that is customer facing is accelerating the take up of cloud, data platforms, and infrastructure enabled AI, in order to improve customer interaction.

"The E&Y research showed that AI continues to be a big part of a company's spend, as they look to respond to the needs of their customers. However, in many cases AI investment continues to lag behind that made in cloud, data and advanced analytics and the Internet of Things, among the companies that were surveyed."

According to Saiz, "The future is about embedding AI in core processes. As a consequence, companies are able to get smarter and better align AI to their process and business needs. It's those companies who are investing more in AI that are gaining the most."

These leaders look at how processes, products and services can be improved through AI, and crucially are able to measure, monitor and assess the benefits that they derive from AI.

Saiz points out that as companies look to invest more so they also need to turn to developing more expansive ecosystems and partnerships, and a growing number of organisations say that forging innovation partnerships is a core priority going forward.

However, establishing partnerships can be a challenge in itself with the need to create the right culture and putting in place the agreements you need to manage and govern the relationship.

"A successful relationship depends on trust, transparency and the equitable sharing of benefits," explains Saiz. It will also require time and resources.

Nurturing talent is also critical and to be successful companies need to constantly be looking to reshape and re-skill their workforce, in order to meet the challenges associated with technological transformation.

"Leaders are developing new incentives to encourage their workforces to learn new skills and in many case introducing mandatory new training programmes," Saiz explains. Business and workforce strategies are increasingly connected.

Technological innovation also needs to be governed properly and ethically, according to Saiz.

"Many of our clients are asking for a trusted framework when it comes to AI - trust is at the heart of ethical governance.

"Ethics is becoming more important and more businesses are looking at establishing executive level governance of emerging technologies, but they still have a way to go. Few have an established framework in operation.

"I believe there is a need for a private/public partnership when it comes to ethics and ethics at scale implies institutional involvement," argues Saiz. "Regulators are a necessary part of the equation, if we are to effectively leverage AI and other emerging technologies."

Saiz concludes by saying that she is optimistic at the way in which AI and technology is progressing.

"We'll see constant innovation and that will have a real impact on people, business and technology. It's a journey and we still have a long way to go, but I'm an optimist."

mmWave technology joins the fight against **viral outbreaks**

Expanding the capabilities of MMW technology is helping to provide insight into the mechanics of viral transfer, offering potential treatments for COVID-19 and similar viruses, as New Electronics discovers

The next breakthrough in the fight against deadly viral outbreaks may be just a higher frequency away. While millimeter wave (MMW) devices are more commonly associated with military applications, remote sensing, security screening and next generation telecommunications, there is an even more pressing need for this technology - breaking down barriers in research in order to gain new insight into the mechanics of viral transfer.

Curt Dunnam, Director of Operations for the ACERT National Biomedical Center at Cornell University, works with a research team looking to perfect biomedical research devices that operate at the higher end of the MMW spectrum.

Initially limited by the physics of waveguide technology, the research team has used advanced componentry and quasi-optical techniques that can now enlist mmWave technology in the search for viral treatments.

ACERT's investigation into constituents of the coronavirus is part of a collaboration with other university teams that has been deemed critical to the coronavirus research effort. So much so that even though the main Cornell campus - located in Ithaca, New York - was forced to completely shut down nonessential services for a number of months, the ACERT centre remained operational so that the team could advance their research throughout the current pandemic.

"Our research is significantly involved in SARS-CoV-2 spike-protein studies," said Dunnam. "A new generation of high-field, high-frequency electron spin resonance spectrometers hold the future promise of more closely analysing fusion peptide structure and function in the current coronavirus as well as other similar viral proteins."

Biochemistry meets electro-magnetic physics

This wouldn't be the first time that EM-driven magnetic resonance has come to the rescue of biomedical science. Thanks to nuclear spin resonance technology, NMR and MRI devices have long been the gold standard for determining molecular structure and diagnosing soft tissue abnormalities such as tumours.

Similar, but more advanced, microwave base electron-spin-resonance (ESR) technology now promises to enable medical researches to identify a chink in the coronavirus armour.

A contemporary research paper, *Coronavirus Membrane Fusion Mechanism Offers a Potential Target for Antiviral Development* – published on April 6, 2020 by collaborating researchers Susan Daniel, Associate Professor of Chemical and Biomolecular Engineering, and Gary Whittaker, Professor of Virology at the College of Veterinary Medicine, Cornell University – described biologists' dependence on leading edge technology.

Below: The Cornell Science Laboratory

"The spike protein, specifically the fusion peptide, allows these viruses to infect cells by transferring their genome," explained Daniel. "Blocking the fusion step is significant because the fusion machinery doesn't evolve and change as fast as other parts of the protein do. So, if you can develop antiviral strategies to reduce that efficiency, you could have potentially very broadly-acting treatments."

Daniel points out that the virus' activities can be difficult to parse through traditional approaches because the fusion process is dynamic and flexible, and the spike protein changes its shape drastically during fusion. Therefore, they needed a means to study this microscopic process in vitro.

"We have unique facilities for doing such confirmation dynamics of proteins," explained Dunnam. "We send out very short, well defined pulses, but at mmWave wavelengths. The induced electron spin resonance signals exhibit an intrinsically high SNR and bandwidth, resulting in several orders of magnitude improvement in speed and resolution over NMR methods."

Virginia Diodes (VDI) built the world's highest power solid-state coherent 240GHz source that puts out 500 milliwatts (a record at this frequency) for Cornell's ACERT centre. Based in Virginia, VDI is a manufacturer of state-of-the-art test

and measurement equipment.

"Increased power enables a very short pulse that provides increased spectral coverage of the sample," added Dunnam. "However, at half-a-watt we can't afford to give up anything through insertion loss, hence we require an extremely efficient isolator."

Faraday rotation isolators – 'isolators' for short – allow electromagnetic signals to pass in the forward direction with minimal attenuation, but with maximum absorption in the opposite direction. However, standard isolators fall short at extreme GHz frequencies. Above the WR-5.1 band (140-220 GHz) loss can climb to more than 5 dB, making obtaining the lowest possible insertion loss a very formidable engineering challenge.

Above: Spectrometer set up at Cornell

Expanding the limits of MMW R&D

For Cornell's ACERT application, reducing forward attenuation as much as possible was particularly crucial because at 500 milliwatts, while still high for a coherent solid-state source, any loss can significantly diminish the spectrometer effectiveness.

"Virginia Diodes referred me to Micro Harmonics," recalled Dunnam. "I was surprised to find there was a company producing a component that not only operates at such a high frequency, but was an ideal fit for the proposed ACERT instrumentation. They had an isolator with the single most important parameter I needed, low insertion loss. They were ultimately able to select one with just 1.2 dB losses at 240 GHz, which is pretty phenomenal."

Micro Harmonics designs solutions for components used in MMW products. Under a two-phased NASA contract, the company successfully developed an advanced line of isolators for WR-15 through WR-3.4 (50 GHz to 330 GHz) applications.

"They fully characterise each individual isolator, which is really important since each one is hand-assembled, meaning there are slight variations in performance," explained Dunnam. "This allowed selection of the device that displayed good performance in the narrow frequency range I was interested in, 239-241 GHz."

Minimising insertion loss to as low as l.2 dB is achieved by reducing the length of an internal ferrite rod to the shortest possible length. The design developed for NASA saturates the ferrite with an unusually strong magnetic bias field, which enables the incident signal to rotate the required 45 degrees in the shortened ferrite rod.

Dunnam went on to point out other engineering challenges faced at such high frequencies. The relatively increased power enables a very short pulse that provides increased spectral coverage of the protein sample. But after the last transmitted pulse in this application, full receiver sensitivity to the reflected decaying electron spin signal is required within 10 nanoseconds.

"Any kind of ringing in the system that is due to reflections can increase 'dead time' and obscure results, so all the impedance mismatches and spurious signals in the system must be less than 0.1%," said Dunnam. "Additionally, the solid-state source multiplier conversion efficiency and stability can be adversely impacted by out-of-phase signals being reflected back. Low port reflection in the isolator helps keep all that in check."

"The solid-state source could be destroyed by too much reflected energy," explained Dunnam. "As the source was expensive to develop and fabricate, I want to protect that investment."

Lastly, the issue of heat absorption needed to be addressed even at sub-watt transmitter power levels. Power in the reverse signal is absorbed within the isolator, resulting in heat. Historically, high heat was not an issue as there was very little power available from solid-state sources at MMW frequencies, but as Dunnam pointed out, 500 milliwatts at 240 GHz is, relatively, a lot.

In his research centre's application of studying viral proteins, wavelengths are short and components are necessarily small and fragile.

To overcome the problem of high heat loads, the Micro Harmonics isolators selected by Dunnam incorporate diamond heat sinks into their design. Diamond is the ultimate thermal conductor, approaching 2200 W/m·K (watts per meter-Kelvin), more than five times higher than copper. Diamond effectively channels heat from the resistive layer in the isolator to the metal waveguide block, and thus lowers operating temperatures for improved reliability.

Engineering a healthier future

By pushing the limits of mmWave technology, engineers are laying the groundwork for the next wave of medical advancement that will help fight against future outbreaks and pandemics.

"What's exciting about our work is we're providing insight into how all this machinery works, which is essential for the development of new antivirals," summed up Daniel.

ARCHITECTURES FOR AI

How are microprocessors architectures evolving to address the needs of artificial intelligence? By **Neil Tyler**

Developers of AI systems have been constrained, to some extent, by the limitations associated with standard microprocessors and while companies have been unveiling a host of new platforms, questions have been raised as to whether the CPUs and GPUs coming to market are capable of meeting the increased workloads required. As a result, do we need new architectures that are engineered specifically for AI?

AI applications require huge amounts of compute resources if they are to produce the desired outputs and that has resulted in the use of a large numbers of multi-purpose central processing units (CPUs) working in parallel, however, none of these are actually optimised to address the processing functionality that AI needs if it is to perform optimally.

An alternative has been the use of GPUs which have, for many companies, become a 'de facto' AI co-processor accelerator. Unlike CPU's they have simpler cores that can provide dedicated VRAM memory. As a consequence, they are able to better handle statistical computation and the parallel processing needs that are required by machine learning applications.

Like CPUs, GPUs can deliver AI processing capabilities, but again they have not been designed specifically for AI.

So how is the microprocessor industry looking to address the requirements of the 'AI chip' with the necessary compute capabilities required?

"AI has been around since the 1950s but it's only today that we're in the situation where all the elements are now, finally, coming together," says Andrew Grant, Senior Director, Artificial Intelligence, Imagination. "There's a huge amount of work going on in this space, and there has been a major shift in the compute capabilities that enable us to deliver AI."

The industry is certainly seeing more AI-driven demand for GPUs but the requirements of AI are now being taken into account at the very beginning of the design process.

"Today's CPUs and GPUs are not sufficiently capable of delivering the workloads that are needed, so there has to be a better way of doing this," says Grant. "What we are seeing is a move to new architectures because it's not necessarily good to deploy hot and power hungry CPUs or GPUs, at scale, and as a consequence we are seeing a growing number of start-ups working in this space developing AI specific architectures."

A good example of this is Bristol-based Graphcore, which has developed the Intelligence Processing Unit. A new type of microprocessor, it has been specifically designed to support artificial intelligence workloads.

According to Graphcore CEO and co-founder Nigel Toon,"It's a technology that dramatically outperforms legacy processors such as GPUs and with a powerful set of software tools has been tailored to the needs of AI developers. When it comes to AI a new kind of processor architecture is required.'

AI related processors

Research carried out for McKinsey suggests that by 2025 AI-related processors could account for almost 20 per cent of all microprocessor demand, and could be worth in excess of £50bn. It goes on to suggest that GPUs will lose out to AI-specific processors and that opportunities for AI chips will emerge at both data centres and the edge.

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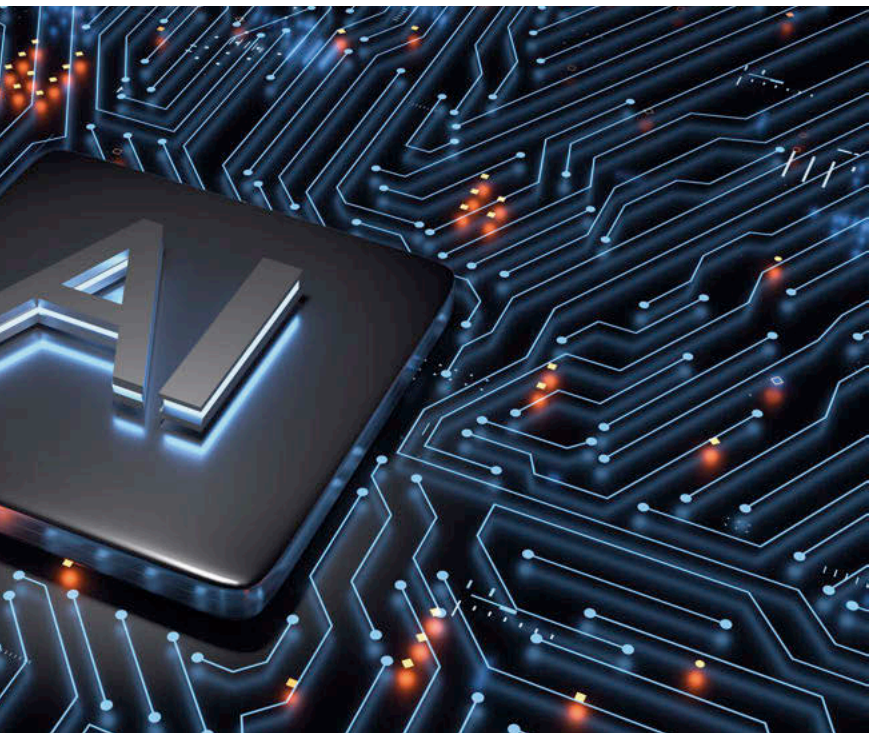
"AI systems developers are looking for processors that have been designed and optimised specifically for AI jobs. That tends to involve many-cored processors with built-in parallelism, that can perform analysis in real-time," explains Grant.

AI chips tend to focus on low-precision arithmetic, novel dataflow architectures, or in-memory computing capabilities and have a closely networked architecture that enables processors to transfer data between them keeping energy consumption to a minimum.

"There's certainly room for new players in this space," according to Grant.

He believes that the level of investment and R&D being committed to AI chip development actually presents a rare opportunity for start-ups, who are going up against established market leaders.

"With new companies we benefit from more competition but that can be



problematic. You can end up creating a diverse, but confusing market, with thousands of companies competing against one another and, to date, few are at the point of delivering silicon."

According to Grant companies are targeting data centres while a growing number have gone after the IoT.

"The AIoT is a very fragmented space. In some cases you can run basic AI tasks on a CPU, or DSP, or use dedicated neural network processors," Grant explains. "It's a dynamic and fast changing market and as a consequence we are seeing neural networks and traditional computing coming together – in a sense playing to the strengths of both."

Last year, Xmos unveiled xcore.ai, what it described as an inexpensive crossover processor that was designed specifically for the AIoT market delivering high-performance AI, DSP, control and IO in a single device.

According to Xmos CEO, Mark Lippett, "This type of capability would traditionally have been deployed either through a powerful applications processor or a microcontroller with additional components to accelerate key capabilities. With this crossover processor we have been able to architect it to deliver real-time inferencing and decisioning at the edge, as well as signal processing, control and communications."

A major issue for designers is power consumption, much of which is consumed as data is moved to and from memory, which in turn raises the question as to how much memory is needed?

Companies looking to reduce the power required to move data across the chip are implementing in-memory architectures that will either move the compute closer to the memory or the compute into the array itself using memory cells to perform certain computations.

As an alternative, IBM is looking at processing in the analogue rather than the digital domain due to the massive improvement in energy efficiency it promises to deliver.

With so much innovation, however, Grant makes the point that for many companies embracing new technologies is simply too challenging, while relying on more traditional approaches is simply less risky and certainly less costly.

"Today's CPUs and GPUs are not sufficiently capable of delivering the workloads that are needed, so there has to be a better way of doing this."
Andrew Grant

"With this crossover processor we have been able to architect it to deliver real-time inferencing and decisioning at the edge, as well as signal processing, control and communications."
Mark Lippett

"Many companies are happy developing AI chips that use conventional architectures, especially when so much has already been invested in their development. It's also a risk for established chipmakers who may well be wedded to a particular programming paradigm," explains Grant.

For companies in this space combining traditional computing architectures with hardware and software acceleration schemes would seem to be a sensible solution, but there does come a point where starting from scratch can result in a much better solution.

From established market leaders like Nvidia, Intel and Qualcomm to start-ups like BrainChip, Graphcore and Xmos new devices have started appearing in short order, all of them looking to stake a claim in this emerging market.

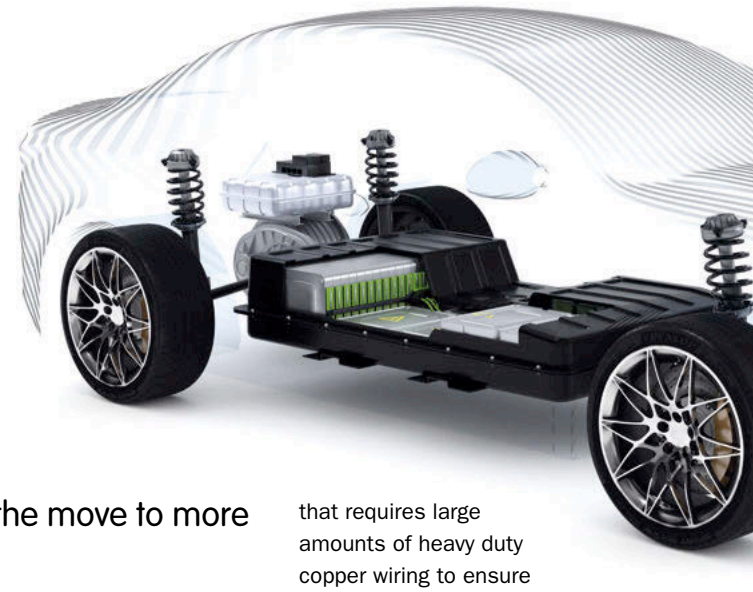
Many smaller companies have focused on specific AI applications and many unique designs and methods for AI applications have emerged, from microprocessor build, to materials and devices, circuits and architectures.

As chip physics gets smaller and smaller, so conventional processor architectures will become less efficient, and developers will have to turn to more innovative architectures.

"There is still a role for traditional CPUs and GPUs," says Grant. "Especially in data centres, but where you need to conduct a particular task new architectures are going to be critical in delivering lower costs, lower power and greater efficiency.

When it comes to machine learning workloads, for example, they're completely new and will require new structures that will not necessarily be supported by existing CPUs and GPUs. "That would suggest that a new kind of processor architecture will be required, but I believe there is still a role for both going forward," says Grant.

‘Revolutionising’ EV battery management



TI unveils a EV battery management solution driving the move to more reliable and efficient electric vehicles. By **Neil Tyler**

As more vehicles become electrified so there is a need for improved levels of functional safety that require much higher levels of accurate battery monitoring.

Tech companies are working hard to improve battery-monitoring accuracy in order to ensure that the vehicle’s battery management system is able to work more efficiently and is able to monitor, in real time, the performance of the individual battery cells.

It’s interesting that elegant technology abounds in the latest EV models but in the chassis underneath there remains a complex mass of components supporting its system of batteries.

EVs are packed with battery cells and, as such, currently require extensive multi-cable solutions to connect each cell to a battery management system (BMS) that is able to deliver the efficiency, longevity and performance that’s required.

EV battery packs can stack up to 1000V and beyond to support the demanding loads of the AC motor and can comprise of hundreds of cells stacked together in series. Distributed battery pack systems are able to support high-cell-count packs by connecting multiple high-accuracy battery monitors on separate printed circuit boards called cell sensing units.

However, operating a high voltage battery pack in a vehicle imposes tough conditions - wide operating temperatures and vibration need to be managed while the battery management electronics are expected to maximise operating range, lifetime, safety and reliability.

Each cell, in such a system, is connected via a complex network of cables and wires to enable performance monitoring and this has raised issues around cost, size and weight. As a result, there’s been a growing realisation that these cables and wires are proving a significant drag on reliability, maintenance and manufacturing costs.

Another issue arises in that to accommodate the large quantity of cells that are now required for high powered automotive systems, batteries are being distributed throughout the available spaces in the vehicle, which requires a sound communication system.

To address these issues companies are now developing next generation BMS that operate wirelessly, ending the need to use the pounds of wiring found in current solutions.

Wireless BMS

Texas Instruments has developed a wireless BMS that not only removes the need for bulky wired solutions, but delivers improved EV reliability.

“EVs are packed with battery cells and multi cabling, so in every EV the BMS is an essential component. Each battery cell has to be connected so it can be monitored but, at present, that requires large amounts of heavy duty copper wiring to ensure reliability. So our BMS is wireless,” explains Karl-Heinz Steinmetz, TI’s General Manager of Powertrain in Automotive Systems.

“Monitoring the battery is critical as is measuring the voltage and temperature if you are to guarantee that the maximum energy is being extracted between charges.”
Ivo Marocco

In theory, removing these wires and additional components will reduce both weight and footprint and improve the vehicle’s reliability.

“Battery management systems are currently connected by wire using a daisy-chain configuration - which is widely perceived as safe. But while it provides reliable communications it is complex using a mass of cabling, wires, connectors and isolation components. The mechanical failure of these components is a common source of cable failures and can prove costly to repair. Replacing batteries is also proving to be ‘super’ expensive,” adds Steinmetz.

According to Steinmetz, the crucial advantage of a wireless BMS is that it significantly reduces the total cost of ownership and eliminates the need for maintenance-prone components.

“A wireless BMS reduces the complexity of the design removing connectors and other components. In a wireless scenario there is a direct link from the BMU to each wireless node that improves the reliability of the complete system.”

TI’s solution is intended to empower automakers helping them to reduce the complexity of their designs, improve reliability and reduce vehicle weight to extend driving range.

But not only that, it also helps to reduce assembly costs too.

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"Today these devices are wired manually so by going wireless it's possible to significantly cut manufacturing costs – there are no complex wiring systems and we no longer need a wiring harness, connectors, transformers or capacitors.

"These advancements provide much greater flexibility of design while also lowering the cost, relative to traditional systems. This is a solution that not only combines these technical advantages but does so with ASIL-D compliance."

Naturally there are concerns with wireless BMS, as they need to be able to monitor accurately in real time. Not only do they need to be accurate but need to transmit data rapidly and with low error rates – made all the more difficult by operating in a hot and noisy environment.

"Monitoring the battery is critical as is measuring the voltage and temperature if you are to guarantee that the maximum energy is being extracted between charges. This new family of devices ensure that its possible to measure these parameters with great accuracy," said Ivo Marocco, director of business development and functional safety for Battery Automotive products at TI.

TI's wireless solution, includes a proprietary wireless protocol, that looks to address these challenges and combines two new chips, the CC266C2R0QI wireless MCU and the BQ79616-Q1 battery monitor and balancer.

The wireless MCU offers dedicated time slots that provide high throughput and low latency to protect data from loss or corruption while enabling multiple battery cells to send voltage and temperature data to the main MCU with, according to TI, a ±2-mV accuracy and a network packet error rate of less than 10-7.

TI's wireless BMS functional safety concept addresses communication error detection and security. The proprietary protocol via the CC2662R-Q1 wireless MCU has been designed to enable a robust and scalable data exchange between a host system processor and the BQ79616-Q1 battery monitor and balancer.

According to TI the wireless protocol for BMS via the CC2662R-Q1 is able to offer the industry's highest network availability of greater than 99.999% and a network restart of 300-ms maximum availability.

"The car chassis acts as a Faraday cage," explains Ram Vedantham, manager of TI's 2.4Ghz Business Line," so, as a consequence, any interference is contained within the systems. Careful design of the protocol, which has combined time-division multiplexing with frequency hopping, means that we've been able to eliminate any noise to the maximum extent possible."

Moving to production faster

Auto manufacturers will be able to advance to production much faster using this wireless BMS offering, as TI has also made available the SimpleLink 2.4-GHz CC2662R-Q1 wireless microcontroller (MCU) evaluation module, software and functional safety enablers such as a safety manual; failure mode and effects analysis (FMEA); as well as diagnostic analysis (FMEDA).

Security is a key requirement when it comes to wireless devices, so to mitigate potential threats TI is making available security enablers such as key exchange and refreshment; unique device authentication; debug security; software IP protection with a joint test action group (JTAG) lock; Advanced Encryption Standard (AES) 128-bit cryptographic acceleration and message integrity checks

"EVs are packed with battery cells and multi cabling, so in every EV the BMS is an essential component." Karl-Heinz Steinmetz

Anticipating automakers' long-term design needs, TI says that its wireless BMS has been designed to be scalable. Automakers will be able to create a battery module using a single wireless system-on-chip that's connected with multiple BQ79616-Q1 battery monitors making it possible to deliver different configurations such as 32-, 48- and 60-cell systems.

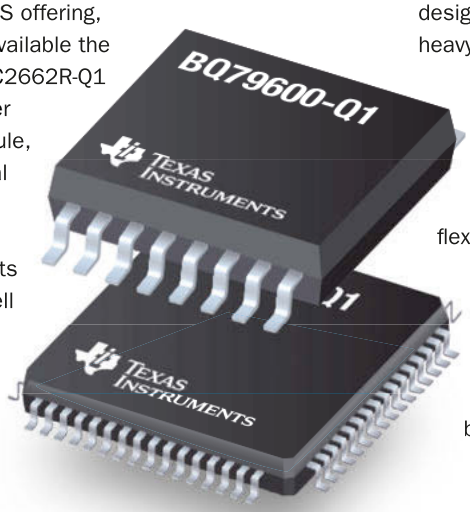
The system is designed to support up to 100 nodes with low latency of less than 2 ms per node and time-synchronized measurements across every node.

The CC2662R-Q1 wireless MCU isolates individual cell monitoring units, eliminating the need for and cost of daisy-chain isolation components, which is the case with existing solutions.

The BQ79616-Q1 battery monitor and balancer is able to offer different channel options in the same package type, providing pin-to-pin compatibility and supporting 100% reuse of the established software and hardware across any platform.

"This move to a wireless BMS solution demonstrates how vehicle designers will be able to remove heavy, expensive, maintenance-prone cabling and improve the reliability and efficiency of EVs worldwide," explains Steinmetz.

"It provides much greater flexibility to scale designs across production models and by removing all these components there's plenty of scope for designers to add more intelligence or more battery cells."



Below: TI's wireless solution combines two chips: the CC2662R-Q1 wireless MCU and the BQ79616-Q1 battery monitor

How to deliver a reliable connector design

What makes for a good connector design, especially one that looks to mitigate electromagnetic interference? New Electronics talks to PEI-Genesis

Few components are subjected to extreme conditions in the way that connectors are. From commercial aircraft or military vehicle to medical ventilators, connectors need to be able to endure extreme variation in conditions.

Whether it's the rapid temperature fluctuations and changes in humidity, to persistent vibration, impacts and signal interference, connectors must be able to operate reliably to ensure their users can get the 'job done'.

"The industry-standard D38999 is a military-specification connector that was originally designed in the 1970s and is now on its third-generation design," explains Ammar Lokhandwalla, customer application engineer at connector specialist PEI-Genesis.

"Like other connectors of its kind, it's made up of a few basic components: a hard outer shell, a neoprene rubber insert with holes to house the pins, or contacts, and sometimes a backshell on the outer housing that provides additional shielding and durability."

When it comes to selecting a connector, engineers need to consider a wide variety of properties depending on their application. One of the primary considerations is the choice of materials, for both the electrical terminations and shell housing. For example, although copper offers better electrical and thermal conductivity, aluminium is cheaper and easier to form and plate.

"While copper may be chosen for high-voltage industrial applications where heat dissipation and conductivity are vital, aluminium may better serve aerospace and military applications where weight and corrosion-resistance are more important," explains Lokhandwalla.

Ingress protection is another consideration and connectors that are designed for industrial food and beverage manufacturing must be sealed against water jets to allow equipment and machinery to be washed down between shifts.

"This protection extends to marine applications, such as those in the oil and gas sector where equipment may need to be fully submersible for prolonged periods of time. In these applications, it may be necessary to select a polycarbonate connector, with the right o-rings and grommets to provide a moisture seal," suggests Lokhandwalla.

While aluminium is the preferred choice of connector material for many construction, rail, industrial and military applications, it may still need to undergo plating to improve its corrosion-resistance, to provide further electromagnetic shielding, and to meet camouflage and colour needs.

"EMI is a serious concern for engineers in almost every application, but especially situations where signal integrity is vital."
Jakub Kosinski

"Some military applications use olive-drab green, a colour that was historically achieved with a toxic cadmium coating," explains Lokhandwalla. "In recent years, this has been replaced with a black zinc nickel plating that meets RoHS and REACH regulations. If engineered correctly, this black plating can deliver the same performance as cadmium coatings and withstand over 500 hours of salt-spray."

Not all connector contacts can be solder-terminated, according to Lokhandwalla, "Under certain extreme conditions, the operating temperature of the application can exceed the melting point of the solder, causing connection failure. For applications where this is a risk, engineers may prefer to specify a crimped connector."

Lokhandwalla makes the point that when it comes to crimping, contacts are joined to the wire by mechanically squeezing them together to ensure that they remain in contact no matter the temperature. Instead of a soldered connection where the wire is fed through an eyelet or hook and

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then soldered, crimping involves material being deformed to lock the termination together using a special crimping tool.

Electromagnetic interference

Electronic equipment is sensitive to electromagnetic interference (EMI) and connectors are no exception, according to Jakub Kosinski, a product manager at PEI Genesis.

"EMI is a serious concern for engineers in almost every application, but especially situations where signal integrity is vital — such as mission critical military communications, fly-by-wire avionics and medical applications. In those situations, EMI can cause orders, control adjustments and medical data respectively to be miscommunicated, with potentially fatal consequences."

The most important aspect of EMI resistance is the enclosure, according to Kosinski, both in terms of it material and topology.

"The enclosure material is the first line of defence against EMI. Conductive metallic enclosures are ideal here, because any electromagnetic waves incoming or outgoing induce a current in the enclosure which saps the energy away from the waves. As a result, they act as an insulating shield, as opposed to other non-conductive enclosures, including plastic ones, which are transparent to EMI and allow the interference to pass through unimpeded."

"One of the biggest mistakes I see manufacturers make is considering connector design too late in the design process of their product." Ammar Lokhandwalla

Enclosure material is critical, even the slightest change can make a big difference. Traditional EMI resistant enclosures have been plated with cadmium to reduce corrosion. This thin plated layer also works to increase the opacity of the material to EMI.

Unfortunately, cadmium has toxic effects on the kidneys as well as the skeletal and respiratory systems.

"Recently, however, more and more enclosures are being plated with zinc-nickel to make them Restriction of Hazardous Substances (RoHS) compliant - zinc-nickel offers similar EMI shielding and corrosion resistance but without using any cadmium, with its associated negative health impacts."

The second line of defence is the topology, or shape, of the connector enclosure.

"Imagine a rectangular enclosure for example. Here, sharp edges act as weak points for EMI to leak in and out of the connector, and flat faces create impromptu waveguides where the EMI is trapped and interferes with itself, creating even more electromagnetic noise," explains Kosinski.

"So, with a topologically smooth, zinc-nickel-plated, stainless-steel enclosure, it is possible to severely limit EMI flux either emitted or absorbed by the connector.

"Backshells like the Amphenol M85049, Polamco 35 Series and Sunbank M85049 are specifically designed to give a 360 degree connection with the cable braid, which offers the best EMI protection for the wire itself."

This way there's nowhere for EMI to leak out of the connection, but what about EMI generated by or already present in the wiring itself?

"This can be addressed from two angles," suggests Kozinski. "The first is to use braided coaxial cabling. Like the conductive connector enclosures, coaxial cables include a conductive sheath to protect the signal wire from EMI. For the best protection, the coaxial sheath should be grounded to the backshell of the connector to allow an escape route for the EMI induced current.

"The second approach is to include filtering components in the connectors which are tuned to pass power and signal frequencies, but remove EMI frequencies. Using filters is quite convenient because they can easily be retroactively applied to typically noisy networks with little to no reworking or redesigns of equipment needed."

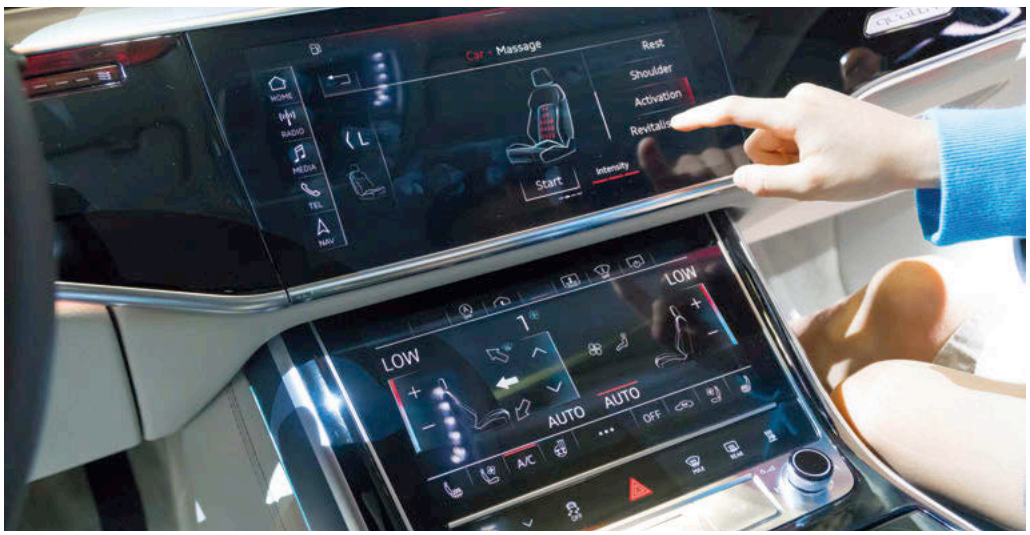
Design early, design once

"One of the biggest mistakes I see manufacturers make is considering connector design too late in the design process of their product. This often means that a product's time to market is delayed while the design is reworked," points out Lokhandwalla.

"It's important to remember that your connector may have physical design constraints like a minimum wire-gauge or number of contacts, so it's vital to consult with your connector supplier early in the process. At PEI-Genesis, we are able to offer customers a 3D wire model of the connector that customers can drop into their design to see if it fits.

"If it doesn't, our engineering team can help refine or redesign the existing design, or propose a different connector entirely, that meets the specification. This includes changing features like threaded, bayonet and friction fittings, or accessories like backshells, or something simple like a dust cap."

A **finger** on the **pulse** of time



How are features associated with interactive displays finding their way into the passenger cell of the future? By **Sebastian Masi**

Smartphones, tablets, televisions: touch displays are ubiquitous and are increasingly being used in modern vehicles - whether for buttonless operation of the air conditioning or infotainment system.

In contrast to consumer electronics, these functions have to face special challenges in vehicles from strong vibrations and changing temperatures to electromagnetic fields. In order to ensure that drivers can enjoy the benefits of touch displays, the technology must therefore be adapted to the requirements of the automotive industry. This is achieved, for example, by integrating state-of-the-art technologies with TDDI or OLED components, but also by means of an extensive testing and validation process with regard to resistance and function.

In this way, it can be ensured that the driving experience is actually enhanced and not diminished by advanced touch displays.

Capacitive sensors are used for touch displays due to their higher reliability and wider range of functions. While panels in household electronics are becoming thinner and lighter, this poses a greater problem for vehicles. There, the sensitive sensor technology is subject to stricter requirements in terms of service life and environmental influences, which is why more robust displays have been developed - but at the expense of lightweight construction. Nevertheless, precise sensor technology is still necessary in vehicles in order to provide the levels of comfort that are associated with modern vehicles.

While high rigidity of components is also important, touch displays should still be flexible enough in an accident to reduce the risk of injury in a collision. It is therefore important to protect the sensors and the driver on the one hand, but also to bring familiar features into the passenger cell on the other.

Outcell, Oncell, Incell

This can be achieved by integrating the individual components into the display. When the electronics are applied to the outer layers (Outcell Technology), they are more exposed to temperature fluctuations, vibrations and electromagnetic fields. As a result, the sensor and the microcontroller need to be built deeper and deeper into the panel (Oncell technology). The advantage of such a design is the basic structure of a touch component: the heart of every touch LCD display is the so-called cell, which essentially consists of a protective TFT glass layer (Thin Film Transistor) on which TFT circuits are mounted.

Above this is a layer of liquid crystals, which is closed at the top by a colour filter and the corresponding glass layer. This entire element is enclosed by the polarization filter. From below, the display is supplemented by a backlight, and protected at the top by a cover glass. The deeper the sensor technology is built into the cell, the more the surrounding components offer protection – and a slimmer, thinner design becomes possible.

Limiting the number of layers, in the optical “stack”, results in lower reflection and improved solar radiation, without increasing the brightness of the backlight.

Initially, the so-called outcell design was common for the development of touch displays. Here, the display was connected to the sensor by a bonding process. The biggest advantage of this design is that any display technology preferred for the application can be used. For example, any commercially available touch sensor that meets the requirements can be combined with the display. However, this means that the sensor technology rests externally on the polarisation filter, which makes the entire component thicker than is desired in consumer electronics.

In order to counteract this disadvantage of the Outcell design, the Oncell design was established

Author details: **Sebastian Masi is Senior Engineer Display & Instruments at ARRK Engineering**

as the next step. Here, the sensors within the display are mounted directly on the cell, which already leads to a thinner construction possibility due to the integration. This trend towards thinner displays is reinforced in the automotive industry today with the complete integration thanks to the Incell variant in combination with TDDI technology (Touch and Display Driver Integration). This allows sensors and even controllers to be moved right into the centre of the display - optimally protected.

The advantages of this design are a thinner module and improved optical quality. The production process itself is also accelerated by this design, since fewer production steps and suppliers are required for an Incell display.

High requirements for road traffic

However, with the complete Incell integration of sensor technology and controller, not all challenges for touch displays in vehicles have yet been mastered. This is because many automobile manufacturers have high demands and special requirements.

One of the most common demands is for a water-proof design, for example, in which touching by raindrops or condensation is recognised and then ignored by an algorithm in the touch system software. Thanks to this technology, the system can be operated even in moist conditions without an unexpected behaviour.

Another often requested feature is a display that allows touch gestures even when passengers are wearing gloves, the details for such features vary from manufacturer to manufacturer and must therefore be tested and developed for the respective performance requirements.

In order to ensure smooth series production, reliable tests that meet the standards of objectivity, reliability and validity are already required during prototype construction.

To this end, the respective test procedures should provide the same conditions for each component.

ARRK Engineering is an automotive service provider and is able to provide test services for display and control systems. All customer requirements can be checked with the help of the comprehensive know-how of the experts for touch displays and extensive analysis and test equipment. For example, automated endurance and stress tests can be used to check certain points in rapid succession in order to detect possible deviations on the entire touch surface and eliminate sources of error at an early stage. In addition, the use of standardised gloves with different materials makes it possible to test functions for different applications.

ARRK can assist with extensive knowledge in the selection of suppliers as well as provide technical and organisational support for the nomination process.

Conclusion

In order to deliver an acceptable driving experience, other trends for touch displays are also finding their way from household electronics into the car. For example, OLEDs (organic light-emitting diodes) are increasingly being used in vehicles, in which each individual pixel represents a light source in its own right.

In conjunction with TDDI technology it is possible to develop curved yet thin touch displays - enabling numerous new designs. Touch and Display Driver Integration is the integration of the sensor into the display electrodes on a single chip. This technology combines touch functions directly with the display, resulting in higher production efficiency and the possibility for brighter screens. Other advantages of such a manufacturing method include a thinner display module, improved optical performance and a simplified supply chain.

Developments such as “Quality of Life” features for haptic feedback are also being integrated into modern vehicle displays. Using different types of actuators, different parts of the display can be moved in the micrometer range. This gives the driver the feeling of actually pushing or turning a physical button. If this is supplemented with “force sensing”, different functions can be activated depending on the force of the fingers applied to the display.

As much as the automotive industry can learn from the use of touch displays in the entertainment industry - the reverse would also be possible.

After all, the increased requirements with regard to heat, vibration and electromagnetic compatibility in vehicles also open up new possibilities for consumer electronics. A smartphone, for example, could benefit greatly from greater resistance despite thin and flexible components. This means that consumer electronics can also benefit from the latest developments in the field of touch displays in vehicles.

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