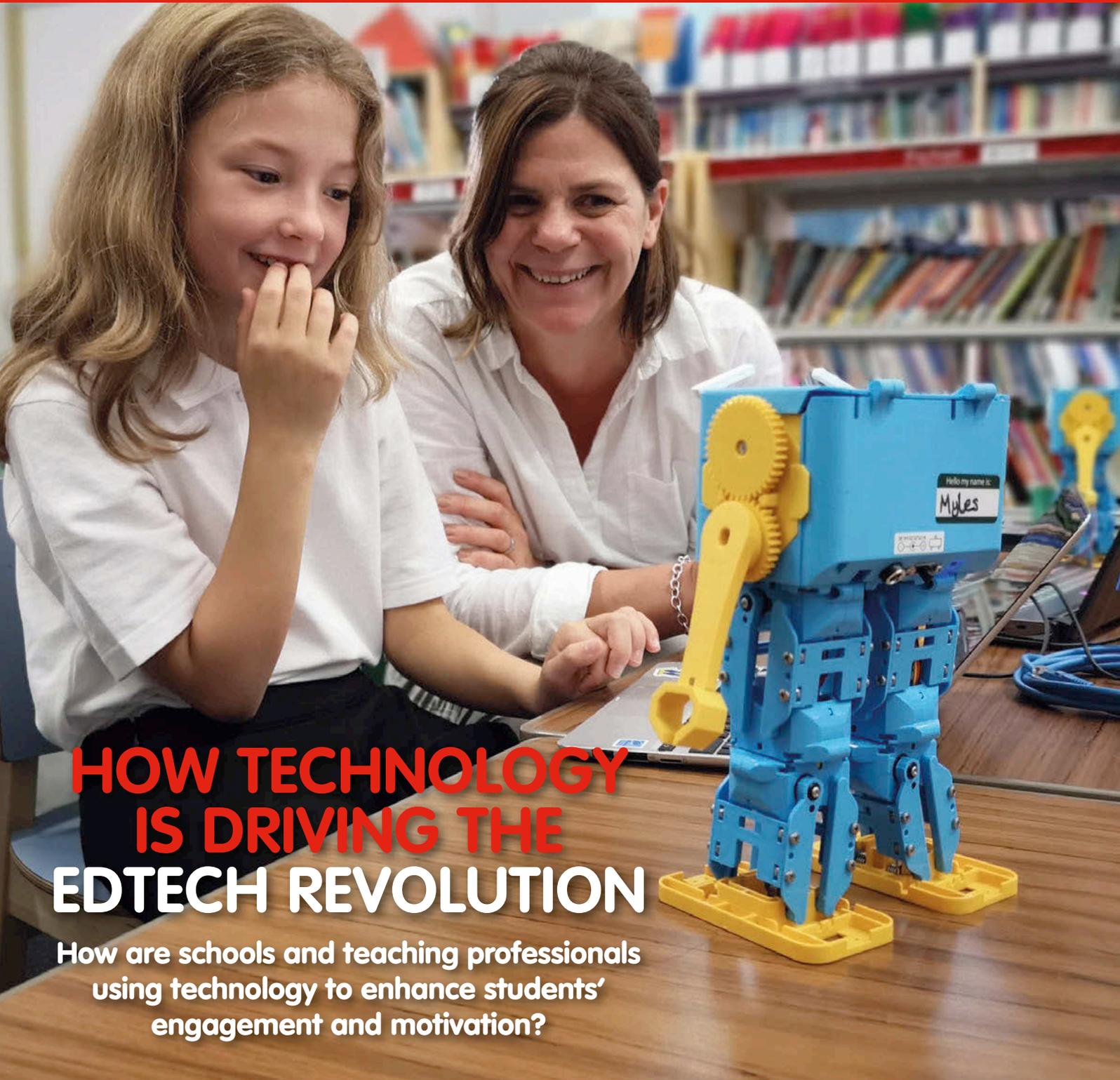


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HOW TECHNOLOGY IS DRIVING THE EDTECH REVOLUTION

How are schools and teaching professionals using technology to enhance students' engagement and motivation?

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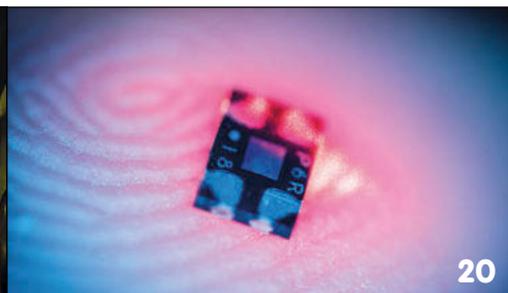
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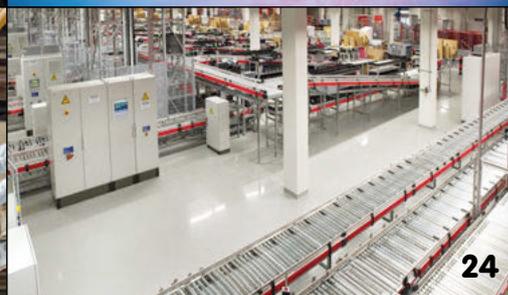
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A teaching revolution

WHEN THE CURRENT CORONAVIRUS CRISIS IS OVER AND LIFE RETURNS TO NORMAL, WILL EDTECH BE PLAYING AN EVEN BIGGER ROLE IN EDUCATING CHILDREN?



Teachers and students alike have, over the past few weeks, had to watch as schools have been shut down and exams cancelled amid the on-going public health emergency caused by the Coronavirus.

According to the United Nations' Educational, Scientific and Cultural Organization thousands of schools have been closed around the world, with hundreds of millions of students facing an educational upheaval that's unparalleled in both its scale and level of disruption.

The implications of the pandemic for the education sector, and the impact it's having, has been so great that it is to be examined in a wide-ranging inquiry by the UK Parliament's Education Select Committee.

Its chair, Robert Halfon MP, has said, "The coronavirus outbreak is going to have a deep and long-lasting impact right across the education sector."

One of those impacts will be the accelerating trend for using more technology in schools, and this crisis has seen a growing number of schools turning to it in order to maintain learning continuity.

Today, the Coronavirus has resulted in the majority of children in the UK now being educated remotely, with schools adopting technology to deliver the best learning experiences they can.

In this issue of New Electronics we look at how technology is being used to revolutionise education, whether through the use of robotics or virtual reality, which has the potential to make education more immersive and impactful, or by deploying artificial intelligence.

While for some the move to use technology will require a significant shift in mind-set, for others it'll be seen as an opportunity to think creatively and to look at new and emerging ways to embed and use technology when it comes to teaching and learning.

While EdTech certainly has a positive perception in terms of its impact on teacher workloads and student experiences, there is often a widespread gap in teacher proficiency, which means that these resources are often under-utilised and are not always able to deliver the potential benefits promised.

So ensuring that technology supports education will require not only better support for teachers but, from the industry itself, greater creativity and a willingness to rethink and redesign technology – keeping it simple and making sure it really does deliver what is promised.

As with any crisis, as the Coronavirus upends the way in which we work, live and engage with one another, plenty of companies in the EdTech sector will be looking to make money by selling their technology to schools.

Critically the EdTech industry needs to ensure that it puts the needs of both teachers and students first, because the risks and costs to both of getting 'technology' wrong will be immense.

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

"The coronavirus outbreak is going to have a deep and long-lasting impact right across the education sector."

Robert Halfon MP

newelectronics**Editor** Neil Tyler
neil.tyler@markallengroup.com**Deputy Editor** Elliot Mulley-Goodbarne
Elliot.Mulley-Goodbarne@markallengroup.com**Contributing Editors** Chris Edwards, Charlotte Hathway,
John Walko
editor@newelectronics.co.uk**Art Editor** Andrew Ganassin
andrew.ganassin@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**New Electronics editorial advisory panel****Trevor Cross**, chief technology officer, Teledyne e2v**Pete Leonard**, electronics design manager, Renishaw**Pete Lomas**, director of engineering, Norcott Technologies**Neil Riddiford**, principal electronics engineer, Cambridge Consultants**Adam Taylor**, embedded systems consultant

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NXP pushes Wi-Fi 6 adoption

COMPANY LOOKS TO ACCELERATE WI-FI 6 ADOPTION ACROSS KEY MARKETS. **NEIL TYLER REPORTS**

NXP Semiconductors is making available a comprehensive Wi-Fi 6 (802.11ax) portfolio, which will significantly expand the number of products and markets able to adopt the latest Wi-Fi standards.

The expanded Wi-Fi 6 portfolio looks to deliver additional connectivity improvements, including symmetric multi-gigabit uploads and downloads, dramatically lower latency, increased capacity, and improved power efficiency across applications.

These technical advancements, however, have so far been limited to premium products, so the company is looking to broaden its portfolio to ensure that these improvements are also made available for large-scale deployment across multiple markets.

“To deliver Wi-Fi 6 to broader markets, OEMs need Wi-Fi 6 options that scale to their needs. They need a family of products that matches the performance and cost needs of their different market segments,” said Rafael Sotomayor, senior vice president of Security and Connectivity at NXP. “With NXP’s latest connectivity solutions, we are making it easier for our customers to invest in our Wi-Fi 6 platform to add Wi-Fi 6 to smart homes, connected cars, and industrial machinery.”

“To date, the adoption of Wi-Fi 6 has predominantly been driven by smartphones. However, we expect significant traction to build within the IoT, infrastructure, and automotive markets throughout 2020 and beyond”, explained Andrew Zignani, Wi-Fi, Bluetooth, and Wireless Connectivity Principal Analyst at ABI Research.

“This growth will be further driven by power- and cost-optimised chipsets such as NXP’s latest offerings, which will increase the viability of Wi-Fi for these other applications and help open up all new opportunities for the technology.”



CEVA unveils sensor hub DSP architecture



CEVA, a licensor of wireless connectivity and smart sensing technologies, has unveiled SensPro, said to be the industry’s first high performance sensor hub DSP architecture designed to handle sensor processing and fusion workloads for contextually-aware devices.

SensPro looks to address the need for specialised processors to efficiently handle the proliferation of different types of sensors that are required in smartphones, robotics, automotive, AR/VR headsets, voice assistants, smart home devices and for emerging industrial and medical applications that are being revolutionised with initiatives like Industry 4.0.

These sensors, among which are camera, Radar, LiDAR, Time-of-Flight (ToF), microphones and inertial measurement units (IMU), generate a variety of data types and bit-rates which are derived from imaging, sound, RF and motion, which can be used to create a full 3D contextually-aware device.

Built to maximize performance-per-watt for complex multi-sensor processing use cases, the SensPro architecture offers a combination of high performance single and half precision floating-point math required for high dynamic range signal processing, point cloud creation and deep neural network (DNN) training, along with a large amount of 8- and 16-bit parallel processing capacity.

Ran Snir, Vice President of Research and Development at CEVA, commented: “With the growth in the number and variety of sensors in modern systems, and their substantially different computation needs, we set out to design a new architecture from the ground up to address this challenge. We constructed SensPro as a highly configurable, holistic architecture that could handle these intensive workloads using a combination of scalar, vector processing and AI acceleration, while utilizing the latest micro-architecture design techniques of deep pipelining, parallelism, and multi-tasking.

“The result is a powerful DSP architecture for sensor hubs and we’re truly excited to work with our customers and partners to bring contextually-aware products to market based on it.”

AI techniques used to improve battery health and safety

RESEARCHERS HAVE DESIGNED A MACHINE LEARNING METHOD THAT CAN PREDICT BATTERY HEALTH WITH FAR GREATER ACCURACY. **NEIL TYLER** REPORTS

Cambridge and Newcastle university researchers have designed a machine learning method that can predict battery health, with 10x higher accuracy than current industry standards.

According to the scientists involved it could aid in the development of safer and more reliable batteries for electric vehicles and consumer electronics.

They are able to monitor batteries by sending electrical pulses into them and measuring the response. The measurements are then processed by a machine learning algorithm to predict the battery's health and useful lifespan. Their method is non-invasive and is a simple add-on to any existing battery system.

Predicting the state of health and the remaining useful lifespan of lithium-ion batteries is a big problem and has limited the widespread adoption of electric vehicles. Over time, battery performance degrades via a complex network of subtle chemical processes, each of which will only have a limited effect on battery performance, but collectively they can severely shorten a battery's performance and lifespan.

Current methods for predicting battery health are based on tracking the current and voltage during battery charging and discharging, but this misses important features that indicate battery health.

"Safety and reliability are the most important design criteria as we develop batteries that can pack a lot of energy in a small space," said Dr Alpha Lee from Cambridge's Cavendish Laboratory, who co-led the research. "By improving the software that monitors charging and discharging, and using data-driven software to control the charging process, I believe we can power a big improvement in battery performance."

The researchers performed over 20,000 experimental measurements to train the model, the largest dataset of its kind. Importantly, the model learns how to distinguish important signals from irrelevant noise. Their method is non-invasive and is a simple add-on to any existing battery systems.

Solid-state digital control of electricity

Amber Solutions, a specialist in hyper-intelligent electrical architectures, is now able to provide solid-state digital control of electricity for a range of devices, appliances, power cord and endpoint.

According to the company, its newly-patented Amber AC/DC Enabler and Amber AC Switch represent the first major breakthrough in electricity control and delivery in more than 70 years and will deliver greater safety, reliability and connected intelligence.

Commenting Amber Solutions' Founder, President and CEO Thar Casey, said, "Solid-state control of electricity changes the rules of the game for everything - security and control systems, circuit breakers, lighting fixtures, appliances, dimmer switches etc. Through commercial implementations of our technologies within the existing electrical

infrastructure of any building, any home or business can add IoT functionality overnight by replacing existing outlets and switches with these products. Manufacturers can now engineer and market powered products with far greater capabilities right out of the box."

According to Casey, the company has received five patents to date and has more than 31 patents pending.

Amber's innovation is an advanced Digital Power Management and Control system (DPMC) - a tiny solid-state device that runs power to highly sophisticated micro-controllers, processors and RF devices directly from the AC main. It eliminates the need for bulky electromechanical components such as capacitors and magnetics that limit the reliability and functionality of devices today, effectively reducing the component count by a factor of 2.5.

LED thermal challenges report

New research from Future Facilities – maker of the 6SigmaET thermal simulation software – has revealed the top challenges and trends in the LED industry for 2020.

With LED usage becoming more common, over the next few years the market is set to be worth in excess of \$50bn, there are a number of challenges associated with their use, including thermal considerations.

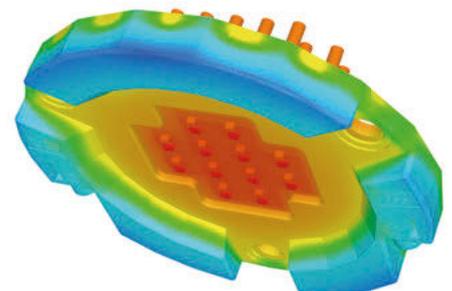
According to the report, the key trends shaping the LED industry in 2020 centre around the need to incorporate LEDs into increasingly compact designs that must be turned around in record time.

These trends are driving a number of new thermal design priorities, with the most commonly identified including: greater customisation due to LEDs entering increasingly niche markets; improved reliability in a wider variety of climates and environments, thanks to the growth in IoT applications and the need for faster thermal simulation tools that provide a higher rate of product optimisation – maximising the efficiency and flexibility of LEDs.

Commenting, Chris Aldham, Product Manager at Future Facilities, said, "Working with such small components means today's thermal simulation platforms must offer an exceptional level of accuracy to prevent overheating and produce reliable end products.

"For LED devices, everything depends on temperature, but temperature depends on everything else. It's so interlinked that it's impossible to look at it in isolation; the entire design process matters. As such, thermal management is vital to ensure that every element of a design is optimised."

Future Facilities has released the key findings of the discussion as an e-book that LED engineers can use to compare, enhance and streamline their own design processes.



Pervasive Displays increases manufacturing capacity

Pervasive Displays (PDI), a producer of e-paper displays, is collaborating with BOE Smart Electronics System to improve the automated production of electronic paper displays (EPDs).

The new automated facility looks to embrace Industry 4.0; adding condition monitoring, automated continuous inspection and quality measurement to increase capacity, improve quality and reduce the potential for faults during the manufacture of its e-paper displays.

The facility, owned and operated by BOE, will give Pervasive Displays access to a fully automated manufacturing facility for displays measuring 1 to 5-inch, and semi-automation for displays measuring 5 to 12-inch.

“Pervasive Displays has been making significant investments in its automated manufacturing capabilities since 2016,” said Scott Soong, Chairman and CEO, Pervasive Displays. “This latest advancement focuses on the lamination and inspection processes of EPD manufacture. With a capacity of 3 million units per month, it is the world’s most productive EPD line.”

By adopting Industry 4.0 approaches to monitor and control the entire process, the production engineering team will now have full visibility into every aspect of the manufacturing process, providing actionable data that is used to maintain optimal throughput with minimum failures.

The facility, based in Chongqing, is owned and operated by BOE Smart Electronics System, which is part of the BOE Group, the majority shareholder of Pervasive Displays’ parent company SES-imagotag.

“Pervasive Display’s focus on materials research, coupled with BOE’s expertise in manufacturing, provides the perfect synergy for the further development and mass production of EPDs,” commented Benjamin Yang, General Manager, BOE

Strategic partnership looks to drive BNNs

XMOS AND PLUMERAI PARTNER TO ACCELERATE BINARISED NEURAL NETWORKS. BY NEIL TYLER

XMOS and Plumerai have agreed a new strategic partnership that will support the development of binarised neural network (BNN) capabilities, enabling AI to be efficiently embedded in a wide range of everyday devices.

The partnership will combine Plumerai’s Larq software library for training BNNs and the xcore.ai crossover processor from XMOS, which has been designed to provide native support for inference of BNNs. The combination is intended to deliver a BNN capability that’s 2 to 4X more efficient than existing edge AI solutions.

The solution is intended for a new generation of devices from managing traffic flows more efficiently to supporting remote healthcare applications. While BNNs are an emerging technology, the future potential is said to be enormous.

A typical application uses deep learning models with tens of millions of parameters — and despite the move to 16-bit and 8-bit encoding there is still an insatiable demand to increase the speed and efficiency of deep learning and AI systems.

BNNs are seen as the most efficient form of deep learning, offering to transform the economics and efficiency of edge intelligence by going all the way down to just a single bit.

There are significant challenges involved in making BNNs commercially viable, however, and XMOS and Plumerai have combined their respective expertise in embedded chip design and deep learning algorithms to enable the use of AI to be extended.

Commenting Mark Lippett, CEO, XMOS said: “BNNs gained prominence in the news recently with Apple’s purchase of Xnor.ai for a reported \$200m. It’s little surprise that Apple is exploring AI capabilities at the edge, with advanced machine learning algorithms that can run efficiently in low-power, offline environments.

“Regardless of other moves in the market, our partnership with Plumerai is exciting for AI developers around the world. The combination of Larq and xcore.ai offers the first consolidated path to commercially deploying BNNs, which will be highly disruptive in intelligent embedded systems.”



Thingstream acquired by u-blox

Thingstream, a provider of IoT Communication-as-a-Service, has been acquired by u-blox, a global supplier of positioning and wireless communication technologies. The acquisition will enable u-blox to offer its customer base complementary value-added services for fast growth IoT projects.

Thingstream’s IoT Communication-as-a-Service looks to remove the barriers to IoT adoption by simplifying the process of getting meaningful data from devices to the cloud securely and at scale. The strategic fit between u-blox and Thingstream will enable both organisations to capitalise on and capture significant market share in the global IoT market.

Thingstream has been adopted by numerous enterprises, many of whom also work with u-blox technologies.

Philipp Bolliger, CEO, Thingstream, said “By joining our business with u-blox we are further able to accelerate the rollout of our best-in-class, low-cost, low-power and global IoT Communication-as-a-Service solution. This in turn enables customers to fast track their IoT deployments with a predictable cost and reliability.”



World's first automated stem-water measuring system

Kerlink, a specialist Internet of Things (IoT) supplier, and Saturas, the developer of a stem-water measurement system for highly efficient farming, have announced that Kerlink will provide Saturas with LoRa-based hardware and software as it launches its

technology commercially.

Saturas, an Israeli startup, has raised about \$9 million, including a €1.5 million H2020 grant from the European Commission in 2019, to support its miniature, tree-embedded sensor system that is able to continuously measure stem water potential (SWP) of trees and vines.

SWP has been scientifically recognised as the most reliable measurement of water stress and an important practical tool for irrigation management. Saturas is the first company to develop a system for measuring SWP automatically, replacing the cumbersome manual devices that fruit-tree and vineyard growers have used for decades.

Using Kerlink stations, the company's tiny LoRa sensors transmit processed data to central, automated irrigation-control systems, tailoring irrigation to crops' real-time needs.

Kerlink will supply Saturas's deployments with hardware and software such as its solar-powered Wirnet iStation, Wanesy Management Centre, a robust solution for managing private IoT networks, and the Wanesy Network-As-A-Service, a comprehensive turnkey offer that combines key infrastructure, operations, security, and professional services.

"Precision agriculture, led by precision irrigation, is a vital and rapidly growing global business sector with an estimated annual growth rate of over 20 percent," said Anat Halgoa Solomon, Saturas co-founder & CEO. "Saturas is positioned to establish a strong presence in this market."

Trackwise acquires Stevenage Circuits

Trackwise Designs has acquired Stevenage Circuits, a UK-based designer and manufacturer of short flex and rigid printed circuit boards, in a deal worth up to £2.5 million and supported by £5.9 million in fundraising.

The deal will enable Trackwise to increase production of its Improved Harness Technology (IHT), as well as expand its customer base and boost technical, sales, and operational expertise.

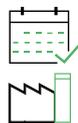
IHT is based on a proprietary roll-to-roll manufacturing process that eliminates traditional size limitations for flexible printed circuits (FPC), enabling Trackwise to produce multilayer FPCs of any length for a variety of demanding applications.

The remaining proceeds will be used to fund additional capacity and capability as well as capital to support growth initiatives including the continued development of Trackwise's intellectual property and knowhow.

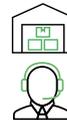
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With teachers and educational budgets under pressure there has been a growing move towards using technology to aid teaching and, over the past ten years, that has given rise to the development of the Edtech sector, which is starting to radically change the face of learning.

However, technology alone is not a solution and if it is to be deployed effectively there needs to be a clear plan and much greater clarity in terms of how it is deployed and used by schools, and that is certainly a challenge for many institutions.

Critically, technology should not be seen as a single solution but should be seen as supporting existing initiatives, helping to empower teachers, so there needs to be clear goals, outcomes and deliverables.

A big part of delivering the benefits of technology is to ensure that staff are better trained and supported - there have been too many poorly implemented projects and many head teachers are said to be losing faith, both in the technology and the levels of investment that are required.

There is no doubt Edtech is changing the way lessons are delivered and will be integral to the classroom of the future. However, there is still a lack of awareness among many teachers of the capabilities that EdTech can offer.

"Where EdTech has been successfully adopted, it is being used to deliver curriculum in an engaging way through teaching aids, online applications and hands on experiences for students," explains James Howarth, Head of Education at RS Components. "However, EdTech is a term that's not wholly understood by many teachers and many are hesitant to invest in technology."

According to Jenny Featherston, user researcher and UX consultant at Sigma, a specialist developer of VR and AR technology, "While EdTech has a positive perception in terms of impact on teacher workload and

How technology is driving the EdTech revolution

How are schools and teaching professionals using technology to enhance students' engagement and motivation? By Neil Tyler

student experience and whilst many learning institutions are equipped with the latest technology, there is often a widespread gap in teacher proficiency which means that these resources are often under-utilised and don't always deliver their full potential benefits."

The EdTech Report, published by RS Components in 2019, reinforced that perception. Despite plans for a £10 million UK government strategy for EdTech in schools, there is a widespread lack of understanding when it comes to educational technology amongst teachers.

The survey found that while half of teachers said they knew what EdTech was, over a third, despite having heard of it, didn't know what it was. A worrying 14% said that they had never heard of EdTech.

These figures are likely to change as the next generation of teachers enters the education system, many of whom will be digitally 'savvy' and can be expected to put growing pressure on schools to embrace technology and to be more innovative in the way that

children are taught.

"While today, schools are continuing to invest in traditional hardware such as desktop computers and increasing the use of smart boards, tablets and other mobile devices, there is now a significant uptake of learning apps to assist in delivering curriculum," suggests Howarth. "These learning apps enable teachers to create lessons, set homework, create dashboards and give grades and feedback. Content can then be easily accessed by students in the classroom or at home.

"In addition, more technology is being used to teach core skills in computer science and design technology, from utilising robotics to teach coding or 3D printing to bring designs to life."

The use of robotics

The use of robotics in the classroom has been a significant development in recent years.

MARTY is a fully programmable, Wi-Fi enabled walking robot that has been designed to be compatible with a wide range of microcomputers such as the micro:bit, the Arduino and Raspberry Pi.

It's the flagship product of a UK company, Robotical, and has been designed for children eight years and older.

"MARTY can be used as a standalone educational tool, or as we recommend, in groups to help children develop team working skills, alongside learning how to code," explains the company's founder and CEO, Sandy Enoch.

Robotical provides supporting materials that address and fit alongside a broad curriculum of Computer Science, Design and Technology, IT and Engineering education for teaching, not just beginners but right through to advanced university level, according to Enoch.

"The EdTech sector is growing rapidly and it is now a giant global



"For engagement to work there needs to be buy-in from teachers."
Sandy Enoch

market and we're seeing more schools embracing technology, whether enabling technology, like iPads, to more disruptive technologies like robotics and other technologies that look to enhance the educational experience."

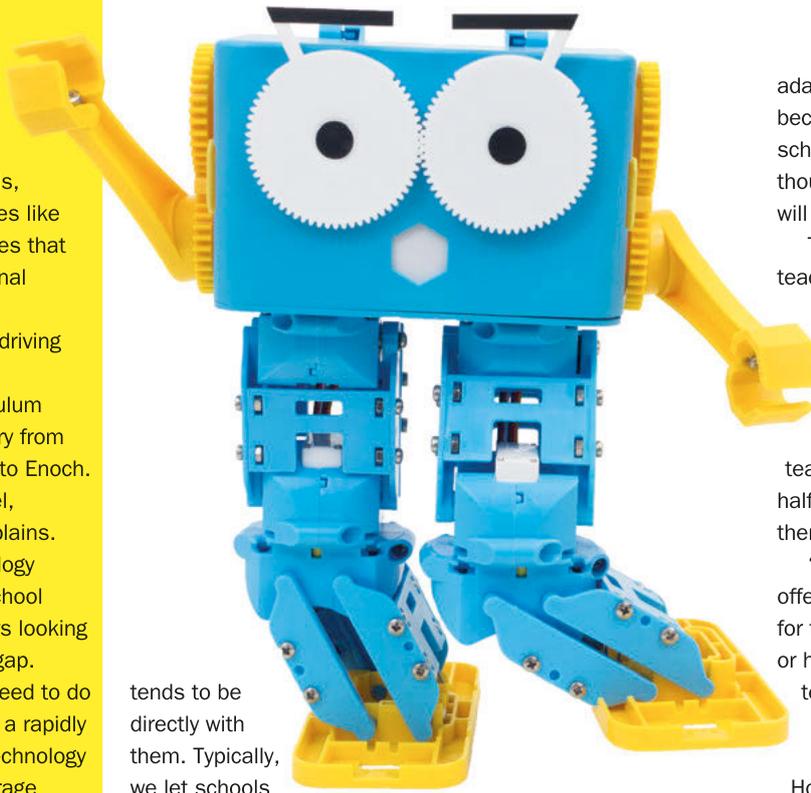
The role of government in driving the adoption of technology is mainly associated with curriculum development and tends to vary from country to country, according to Enoch.

"It's more at the local level, particularly in the UK," he explains. "Here the adoption of technology tends to be on a school by school basis, driven by head teachers looking to address the STEMs skills gap.

"Schools know that they need to do more to get kids prepared for a rapidly changing work market, and technology is certainly one way to encourage more children to look at STEM and to get a better mix of students, in terms of gender and background.

"MARTY has been designed to have a character and we've found that it certainly has a strong gender appeal.

"We have been working with a number of schools and while we do talk to IT providers our engagement



tends to be directly with them. Typically, we let schools try out MARTY to see whether it's a good fit and we offer further support through providing training workshops and coaching for teachers."

The training of teachers was highlighted in the RS EdTech Report which found that despite advances in educational technology in schools, many teachers were struggling to

Above: MARTY is a fully programmable, Wi-Fi enabled robot

adapt to these new ways of learning because of a lack of training, meaning schools are at risk of investing thousands of pounds in EdTech that will fail to deliver.

The report found that the lack of teacher training was most evident at Academy schools, where 60% said they didn't think there was enough training available when it came to technology.

This was a similar scenario for teachers at public schools, with over half (54%) saying they didn't believe there was enough training available.

"Whilst some Edtech providers offer a variety of training platforms for teachers through online tutorials or hands on CPD, there are many teachers who do not believe they receive sufficient training for the equipment they have," says Howarth.

"It is vital that schools invest in providing relevant training to support the implementation of Edtech and ensure teachers can benefit fully from the technology, and deliver with confidence in the classroom."

Enoch agrees. "For engagement to work there needs to be buy-in from teachers and there is a lot of fear when it comes to using new technology. Often schools will spend a lot to bring technology into play, but then under-utilise it because teachers find it hard to use or simply don't know how to use it."

Teaching aids are available, many of which will be tied to curriculum needs, but as Enoch suggests, "a lot depends on the type of school or the headteacher – there are thousands of schools across the UK and not all of them will be looking to address problems through technology."

At a time of budgetary restraint for many schools, those most in need will be spending their limited budgets elsewhere.

"More could be done at the central level," Enoch suggests, emphasising the importance of on-going teacher development.



AI and data

“The coming years will see technology continue to disrupt the way we live and work, meaning there will be more emphasis in schools to use Edtech to prepare students for a digitally driven world,” says Howarth.

“The demand from industry will increase the need for students to learn digital skills which can be delivered both in the classroom and virtually. This can only be achieved with an increased uptake of Edtech in schools and the continued development of technology in this space.”

“The potential of AI in the classroom environment is huge, from personalising learning experiences to reducing teacher workload. But despite Government exploration groups and some inspiring examples of use, it’s fair to say it’s still in its infancy compared to other sectors. The next 5 to 10 years will undoubtedly see a shift in how we think about these technologies and their central role in the classrooms of the future and the current Covid-19 situation will most likely accelerate that thinking,” says Featherstone.

Technology can certainly help improve access to education and the use of digital textbooks means they can be accessed online as and when they are required, and digital copies are relatively cheap to produce.

Technology can also make it far easier to tailor and provide differentiated learning which allows students to be taught in a way that meets their own personal needs.

Extended reality encompassing virtual, augmented, and mixed reality will also bring immersive learning experiences to students,

If teachers are able to access a variety of learning tools through technology they will then be able to give students a far more differentiated learning experience.

The use of technology can also help institutions and educators to be more effective and efficient though



analysing data derived from how digital resources are consumed or which educational technologies are used.

As students interact with connected IoT devices and other digital tools, for example, so more data will be gathered and that can then be used to enhance lessons. It will also make it easier to identify those technologies, or tools, that simply aren’t effective.

Big data, machine learning, and artificial intelligence, will be able to provide for more in-depth personalisation of the content for an individual’s learning needs and provide students with more support where, and if, its required.

A £4.6 million funding programme has been unveiled by the Department for Education (DfE) to test EdTech in classrooms in the hope that this will kick start innovation and de-risk future investment by technology suppliers, as well as schools, helping make schools more educated consumers when it comes to technology solutions.

But, as with many sectors, the growing use of technology will also see increased cybersecurity threats, potentially posing a risk to student data and day-to-day operations. In response, schools will need to

Extended reality will bring immersive learning experiences to students

introduce robust cybersecurity and business continuity strategy employing encryption, managed cloud services and better levels of authentication to limit and contain these threats.

“Over the next five to ten years we will see the development of AI for personalised learning, reduction in teacher workload, automation of tasks, insight into student performance, identifying intervention needs,” suggests Featherstone.

“With little warning Covid-19 has resulted in the majority of children being educated remotely with schools adopting technology to deliver the best learning experiences they can during this new, albeit temporary, reality. “Schools in the UK have obviously been embedding digital learning into their classroom practice for years, but many will be on a very steep learning curve right now,” she suggests.

“For some this will enforce a shift in mind-set and a brave leap into a world they may have been hesitant to embrace but for others it’s a welcome opportunity to think creatively, to share and seek best practice from the global community and to look at new and emerging ways to embed technology into their teaching and learning.”



“Technology will disrupt the way we live and work, and there will be more emphasis on schools using EdTech.”

James Howarth



MANHATTAN SKYLINE

Character

Graphic

ICON

TAB

COG



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Ethical Concerns

Kyle Dent talks **New Electronics** through some of the ethical issues that have to be considered when developing and using artificial intelligence

Data is often biased, incomplete or not reflective of the real-world situation it's supposed to model. As a result, AI developers necessarily make decisions and choose trade-offs.

Self-driving car designers choose to have their cars drive the speed limit and not the safest speed. That's an ethical decision, but probably without much thinking about it in those terms.

There is a general feeling that technology is inherently neutral even among those developing AI solutions. This misunderstanding presents a growing challenge as artificial intelligence evolves and spreads into virtually every facet of human society.

Over the past twenty years, AI has been adopted for many new applications with a big ripple effect on people's lives. How we apply AI is starting to matter, which means the developers of smart systems have an obligation to consider very carefully any potential for harm. We need to bring the ethics of AI front and centre.

This issue is compounded by the fact that most people trust their technologies without really understanding how they work, or recognising their limitations.

Consider the driver, who in 2016 trusted enough in her GPS system that she mistakenly steered her vehicle directly into Georgian Bay in Ontario, Canada. Earlier that same year we saw the first fatal crash of a Tesla Motors car that was being driven in Autopilot mode. Putting undue reliance on the car's semi-autonomous controls despite the manufacturer's warnings, the Tesla driver collided with a tractor-trailer resulting in his own death.

You can't argue with a machine

A major side-effect of the common belief that machines are unbiased is that any debate about decisions is often shut down once an intelligent agent is introduced into the process.

AI technology is already being used for decisions about judicial sentencing, job performance and hiring, among many other things. There is no denying that without technology, human beings bring their own biases to decision making, but those decisions are often questioned amid robust public debate.

Consider the California judge who narrowly escaped recall and faced public outrage at his sentencing decision in a sexual assault case.

People seem to believe that technology is inherently neutral, so its decisions must be fair. What's lacking with AI, however, is any

discussion about how developers chose data sets, selected weighting schemes, modelled outcomes or evaluated their results or even what those results are.

Those affected often have no recourse because computer decisions are considered infallible and usually final. One widely reported and commented on system is now being used in several US jurisdictions to predict a defendant's likelihood to recommit a crime. An AI system that was used to predict risk assessments for criminal recidivism in the Florida courts was found to be quite unreliable in predicting who would commit a crime, scoring only 20 percent, in terms of accuracy, of those it said were likely to commit a violent crime in the future. It was also reported that there were significant differences in the types of errors the system made when analysing white and black defendants. While their findings are disputed by the company supplying the software, the company did not disclose how they determined the risk scores the system produced, claiming their techniques to be a 'trade secret'.

Using AI shouldn't eclipse existing laws and traditional protections extended to those affected by it.

Historically, society in the West have favoured open government and have held human rights values that include human dignity, public health and safety, personal privacy and extend legal protections, even to criminal defendants.

Those with the authority to procure technology and those making use of it, must be aware of its design, its context for use, and its limitations. At a minimum we need to maintain established values. As a society we have to consider who benefits from the use of the technology and who accepts the risks of its use.

Average consumers, business users and government agencies, usually aren't qualified to assess the relevant AI data models and algorithms. This asymmetrical relationship puts the burden on AI developers to be forthright and transparent about the underlying assumptions which guide their decisions.

Adopters of technology also have a responsibility to hold vendors accountable and require disclosure of relevant information.

In the case of decisions affecting sectors of the population who have been historically disadvantaged or marginalised, it is especially important to understand the benefits and risks of using the technology, in addition to understanding the reliability and accuracy of that usage.



Intelligence is only as good as its data

Most modern AI decision-making systems gain intelligence from existing data, so it's critical that we review that data to understand how well it aligns with the real-world goals of the system.

Training data does not always reflect variables from the actual environment where they are deployed. It's often repurposed after being collected for other purposes.

Real-life is complicated and messy. It can be difficult or even impossible to accurately define value functions that match the end goal. Whereas humans are good at ignoring obviously irrelevant data, it often doesn't even enter our minds, machines are not good at reasoning about causal factors. They are really good at finding correlations whether they matter or not.

Performance accuracy is another important consideration. A model with 99 percent accuracy would rightly be considered as providing excellent results by any AI developer. But how many developers ask themselves about the real people who are within that 1 percent where the system gets it wrong?

What if hundreds or thousands of people are adversely impacted by the system? Is it still worth using?

In these cases, systems could be designed to allow for human input to compensate for the system's misses. The size or severity of potential negative consequences should justify extra cost and effort to add protections into the system.

Evaluation of a system should continue even after a system is deployed. The world is highly dynamic and fast-changing. AI systems should incorporate ways to assess post-release accuracy and calculate how often that accuracy should be reviewed and recalibrated.

All of us should be asking hard-hitting questions about AI systems which impact individuals, communities, societies and our shared environments. Are there some specific groups which may be advantaged or disadvantaged in the context of the algorithms under development? When using human data, do the benefits outweigh the risks for those involved? Will there be a calculation of the error rates for different sub-populations and the potential differential impacts? And what are the effects of false positives or false negatives on the subjects who are misclassified?

The developers of AI systems can help mitigate a broad range of future problems by paying close attention to all the decisions which influence their software and data models.

If these decisions are not surfaced and thoroughly examined in advance, we risk incurring a tragic and costly backlash from the growth of artificial intelligence.

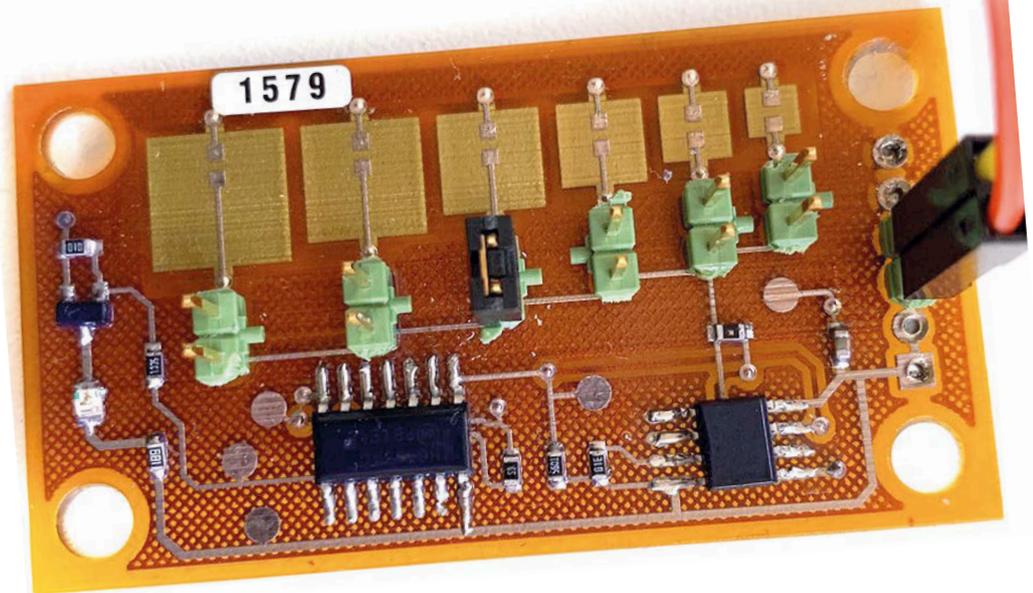
Kyle Dent

Located in Silicon Valley PARC (Palo Alto Research Center), a Xerox company, is a leading scientific research and Open Innovation company.

Kyle Dent is a Research Area Manager, focused on the interplay between people and technology. He leads the ethics review committee at the centre.

Integrated passives have a lot going for them. They take up less space on a PCB, they simplify design and they can, with the right processes shrink circuit tolerances thanks to closer component matching. The downside is that, as with semiconductors, volume is everything.

Although a common reason for keeping passive components off-chip is their size relative to that of the transistors on-die – is not worth wasting precious silicon area on devices that cost more to assemble than their materials are worth – many off-the-shelf parts rely on passives to tune filters and control loops for specific applications.



Passives' push for circuit

Novel features provide routes for integrated passives to a wider market. By **Chris Edwards**

Few designs have sufficient volume and sensitivity to circuit size to warrant the shift to integrated passives. It often makes sense to trade the PCB space and circuit tolerances against setup costs.

As a result, it is no surprise that the market size for integrated passives is dwarfed by that of discretely. Even though they are making inroads, the relative growth of integrated passives is only slightly faster than that of the main market. Research & Markets expects the integrated-passives sector to grow around 8 per cent per year over the next five years, while estimates of the total passives market point to overall growth of around 7 per cent over a similar period.

Integrated passives are mostly making inroads in specific areas. Kemet sees an opportunity for its Konnekt product line in power applications. In contrast to the wafer-based production of a typical EMI filter, the Konnekt design packs together several ceramic capacitors into a stack using a liquid-phase sintering process.

The parallel array of capacitors leads to lower parasitics, with further reductions in losses made possible by placing the electrodes in parallel on the PCB, which gives the package a slightly larger footprint. The standard orientation is taller to allow closer packing.

The biggest market for integrated passives historically, commanding 60 per cent of the total in 2017 according to Yole Developpement, is for devices that filter I/O lines for EMI and electrostatic discharge.

The advantage of an integrated device is that the module can combine Zener diodes and similar active devices with passive elements to create readymade filters.

As the EMI and discharge needs of parallel I/O buses tend to be similar across a wide range of applications, it is an area that readily supports standard integrated products.

Many of them use the same kind of thin-film processes as those used to form semiconductors and can incorporate active devices. As a result,

Above and right : Nano Dimension has demonstrated PCBs that incorporate printed capacitors

traditional silicon vendors such as On Semiconductor and STMicroelectronics have a strong showing.

Extended operating range

Although ease of assembly is one motivation for using integrated passives, the use of semiconductor-type processes can extend the operating range of the circuit elements themselves.

Thanks to the DRAM market's drive for integration, etching and material-fill techniques on silicon support capacitance areal densities of more than 200nF per square millimetre. Acquired by Murata in 2016, France-based IPDiA commercialised a process that took the traditional trench capacitor and repackaged it in a form suitable for use in dedicated integrated passive devices.

One area where the Murata devices fit is in high-temperature applications. Conventional ceramic dielectrics tend to degrade when operated over 150°C, although the liquid-phase sintered materials employed by Kemet can

tolerate higher temperatures because they remove the need to use lead-based solders in the packaged part.

Silicon-based materials can survive temperatures as high as 250°C with the added advantage of supporting miniaturised form factors, suiting them to use in down-hole sensors for drilling rigs as well as in automotive-engine manifolds. The devices have found applications in medical implants because silicon does not degrade in the body and the technology's support for miniaturisation. Another target for the devices is in broadband optical communications because they can support frequencies that stretch into the 100GHz range.

chipmakers.

The traditional customer for front-end filters has been the handset OEM but this is beginning to change through the efforts of fabless specialists like China-based Xpeedic who are designing integrated passives built at foundries for the manufacturers of power amplifier modules.

A similar market is opening up in processors because of the need to pull power and decoupling devices into the package, another area that Murata is beginning to target with its silicon capacitors. Such passive circuitry could go into the outer organic package or through production at silicon foundries into the silicon

mould electronics. TactoTek has developed an injection-moulding process that can support surface-mount components and printed interconnects: the components are placed before the package is moulded into shape. Though heat is an issue in the thermoforming process, the company says a number of chip-scale and leadless package forms are compatible with it.

An alternative to placing components before forming comes through the advent of 3D-printing technology: create the components as part of PCB or enclosure fabrication process itself.

Last autumn, following on from work to build printed planar coil inductors, the 3D-printing specialist Nano Dimension demonstrated PCBs that incorporate printed capacitors ranging in storage values from 0.1nF to 3.2nF. The capacitors were printed using the company's combination of silver conductive ink deposited alongside a polymer dielectric.

The relatively flat capacitors cover a larger surface area than conventional surface-mount ceramic parts: additive processes have a long way to go before they can make the ability to create the fine nanostructures that support the high capacitance densities of semiconductor etch-and-fill processes. But 3D printed opens up the possibilities of creating circuits on curved and irregular surfaces such as the inside of a casing that may give the manufacturer more space to play with. The printed technology has also found applications in medical devices, where they are deposited on the end of a flexible probe.

To try to carve out other niches, manufacturers of integrated passives are looking at alternative substrates such as gallium arsenide and glass to take advantage of their specific electrical and thermal properties. Though it remains a smaller corner of the overall passive market, it is gradually extending tendrils further into the core of electronics design.

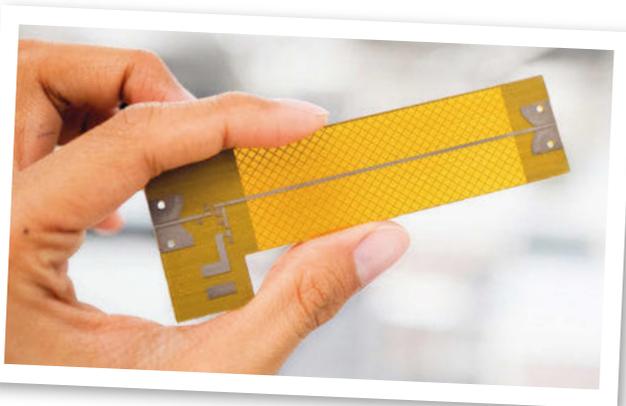
integration

Lower breakdown voltage is a potential issue for silicon-based devices compared to conventional capacitors when very fine structures are used. At the high end of the capacitance density range, the breakdown voltage for the Murata silicon capacitors is around 10V. But by reducing the density to less than 10nF per square millimetre, the breakdown voltage can be pushed above 150V.

Although the focus has been on high-performance capacitors, Murata is looking to extend the integration to support onchip inductors and resistors to support a wider range of circuits, such as the front-end filters in mobile handsets, joining suppliers such as On and ST and a number of other recent entrants as supply chains change.

Growing competition

Packaging and semiconductor suppliers are now competing with each other rather than one simply buying from the other. ASE and StatsChippac are two packaging houses that have moved into this area by supplying foundry services to OEMs and other



interposers used for some advanced system-in-package designs.

Although mobile handsets are seeing passive circuitry sucked into IC packages, the need to customise systems designs means many of these parts still need to be placed on the PCB. However, space pressures can lead to the components being placed either inside the PCB substrate itself or moved to the outer package. Over the past couple of decades, some PCB fabricators have offered technologies that encapsulate standard components within the layers of the substrate to try to free up space on the outer surfaces.

An alternative is to move to in-

Over the past decade it's been estimated that around a quarter of greenhouse gas emissions have been derived from agriculture, forestry and other land use. That's just behind electricity and heat production and significantly ahead of industry in terms of emissions and the impact the sector has had on the environment. Research also suggests that at the current rate of emissions, together with poor water availability and elevated ozone levels, crop yields could fall by as much as 35% in the next 80 years and with global temperatures continuing to rise, every additional degree correlates to a 5-15% drop in overall crop production.

So, we need to be much more thoughtful and efficient in terms how we use land and that calls for more accurate and current information. In response, a growing number of companies are turning to technology to deliver solutions and applications that are capable of enabling people to act on and create strategies based on data.

Located in San Francisco, Arable Labs builds tools that help farmers and growers to collect and then synthesize site-specific agricultural data.

"Agriculture is confronted by a number of challenges today," explained Arable CEO, Jim Ethington. "Among them, how do we continue to produce food in the face of climate change; how do we manage scarce natural resources and what impact are our actions having on the environment,"

"We need to address these challenges and at the core of our response has to be, we believe, how we use data and technology to advance agriculture by providing more accurate measurements, insights, and predictions that will enable growers to recognise and address these problems.

"There's a massive opportunity to



DATA DRIVEN FARMING COMES OF AGE

US company, Arable Labs, has launched a tool that has been designed to drive data-driven farming. By **Neil Tyler**

bring greater efficiency, sustainability and productivity to agriculture through the use of technology. Today, we've got a set of tools that will enable us to tackle these problems. There are IoT devices, advanced sensors, the use of data capture, predictive analytics, and the ability to measure and model systems. We've also got a growing machine learning ecosystem that can take data and do something useful with it at scale."

Empowering farmers

Arable empowers agricultural stakeholders to more effectively manage resources and lower waste, according to Ethington.

"We want to enable people to make more effective decisions around the use of natural resources through the use of data and science.

Above: The Mark 2 device is described as an all-in-one weather station, crop monitor and irrigation tool.

We are using cutting edge technology to help people who face having to make these decisions every day, and who do so under increasingly volatile conditions. We are re-inventing the way that data is made useful to farmers."

Ethington conceded that it is only in the past few years that the technology and infrastructure has been put in place that supports connected devices in the field, which are not only durable, but also reliable and accurate.

"Today's ecosystem enables us to combine more data with greater accuracy to deliver the data science driven models that are proving so useful to growers."

Arable collects data and, when combined with analytics, it can be used by farmers to adapt to new and

changing conditions. Based on its existing Mark device it has now come up with a host of new agronomic solutions.

“We’ve taken our flagship Mark device and based on what we’ve heard from early adopters, we’ve identified pain points and come up with a set of new ideas that enable our new device, the Mark 2, to bridge the gaps that exist between measurements and models.

“We are now able to incorporate deep machine learning, robust data science, weather modelling and remote-sensed data fusion to radically reshape the way we conduct farming,” explained Ethington.

The Mark 2 is described by the company as the world’s most advanced all-in-one weather station, crop monitor, and irrigation management tool.

“It is a solar-powered IoT device that is able to synthesise both climate and plant data to produce actionable insights for all growing conditions around the globe. The Mark 2 features more than 30 enhancements to our original device, including improved sensor accuracy, expanded cellular connectivity, extended battery life, and a protective UV coating to withstand extreme temps and harsh environments,” explained Ethington.

The device is able to measure over different 40 elements, including rain, solar radiation, canopy cover, crop water demand, environmental stresses and microclimate indicators.

The Mark 2 can also be integrated with third parties and Netafim, a specialist in precision irrigation, is currently collaborating with Arable to integrate its data into Netafim’s automated irrigation and fertigation cloud-based platform, NetBeat.

“Arable’s field sensors and plant metrics have been combined with the NetBeat platform to provide more precise, and more reliable, irrigation, fertigation and crop management decisions,” according to Ethington.

Streamlined farming

“The Mark 2 is also able to sense the temperature and spectral conditions of the crop. That means we can determine how rapidly the crop is growing, what its current growth stage is and how stressed the crop is and in many cases the cause of that stress,” said Ethington.

Hourly water stress tests, based on comparisons of the crop’s temperature and that of the air temperature, can show whether the plant has enough water.

“That test means that producers can streamline their irrigation plans and link decisions to outcomes for effective land and resource management,” explained Ethington.

Because Arable’s solution can be integrated with third-party data it’s also possible to provide hyper-local weather forecasting and enhanced satellite imagery.

“When it comes to weather forecasting, Arable uses the measurements on the ground to augment global forecast models to make each forecast specific to the grower’s field,” said Ethington.

According to Ethington, weather forecasts tend to operate on large grids, up to 60 miles across.

“That’s not specific enough for reliable decision making,” Ethington explained, “so by taking the best forecasts available, adding in accurate, continuous ground data,

“It is a solar-powered IoT device that is able to synthesise both climate and plant data to produce actionable insights ”

Jim Ethington

and using machine learning models that will improve over time, Arable is able to create a new level of accuracy in predicting key weather outcomes that will help to improve forecast accuracy by as much as 30%.”

The current use of satellites by farmers is problematic, according to Ethington, as the images generated don’t tend to be frequent enough and can be too dependent on good lighting conditions on the ground and can be unreliable because of cloud cover.

“By taking zero-interference measurements directly above the plant canopy, with the same types of sensors that are used on these satellites, Arable is able to give much more timely and reliable data – usually at five-minute intervals – and provide recommendations that take into account every corner of a grower’s field and every key event of the growing season.”

Connectivity has always been a challenge but Arable has been able to deliver a reliable and simple method of connectivity, that takes advantage of cellular technology solutions that are able to connect to existing cell towers.

“There are no complex local radio networks to manage and we can operate at a range six times greater than that of a typical cell phone, so we’re making farmland more connected.”

In countries like Brazil it will increase the number of connected fields from just 7% to 70%, and that is expected to grow in the coming years with additional investment in cellular infrastructure and the advent of 5G.

Arable has been able to put key data about the growing season in one place for the first time, and by providing better data and analytics via a device that can be installed in a matter of minutes, it is helping to make agriculture more resilient, giving the sector a chance to rapidly adapt to changing conditions.

Below: Previous attempts to monitor crops have required the use of multiple forms of technology



Sensor design is often described as straightforward and better performance can usually be achieved in terms of power, measurement time or sensor size. Sometimes, however, new core technology can change fundamentals, as when high efficiency LEDs replaced light bulbs, and today that's happening when it comes to optical gas sensing technology.

One problem when using efficient LED technology is a more power-hungry sensor. To understand this, we have to dig into the fundamental physics associated with sensor design.

Non Dispersive Infra-Red (NDIR) gas sensing is used extensively when it comes to gas sensing and is robust, reliable, and cost-effective. It also provides maintenance free operation and is seen as an obvious choice for industrial as well as consumer applications.

NDIR gas sensing belongs to a family of sensing techniques where energy is first converted into a physical signal, the signal is then affected by the target of the sensor and that signal is then located by a detector.

In this case, energy is turned into light, the light is then absorbed by the target gas in proportion to the concentration of gas and, finally, a light detector measures the remaining amount of light.

The method involves a number of engineering issues such as providing a stable optical path with a length that is adapted to the measuring range according to the Beer-Lambert law, where a longer path tends to give higher resolution but at the cost of earlier saturation.

Also, the interference filter that selects the wavelength range for the detector must be selected with care to maximise sensitivity to the target gas. It must be able to suppress cross sensitivity to other gases, reduce sensitivity to production tolerances, as well as minimise

Optical gas sensing technology

Today's NDIR gas sensing technology can now provide a low power, yet robust and reliable, gas sensing capability, as

Henrik Rödjegård and **Staffan Ehde** explain

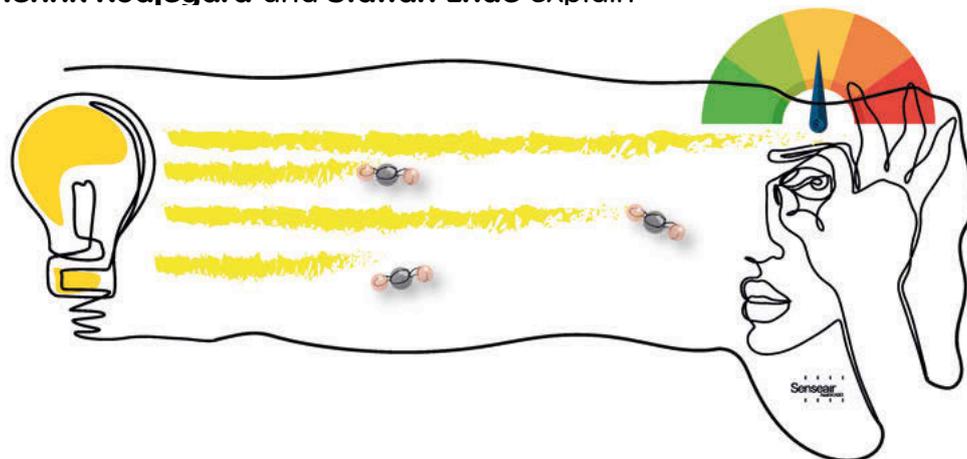


Figure 1: With NDIR gas sensing, the infra-red light is passed through the gas volume and sensed by a narrow-band detector that is tuned to match the absorption wavelength of the gas

temperature and ageing drift.

The electrical driving and readout system must also be carefully designed in order to utilise the AD converter capacity.

Normally, the light source is switched with an on-time of about 100ms, in order to compensate for thermal drift and interference from ambient light and electrical signals. Correlated double sampling is normally used where the signal of interest is derived by subtracting the detector signal when the light source is turned off from the detector signal, when the light source is turned on.

The time period of 100ms is selected since it can perfectly suppress 50Hz and 60Hz

disturbance, and it is compatible with the relatively slow time constants of incandescent lamps and thermal IR detectors such as thermopiles and pyroelectric detectors.

This family of sensors, that convert energy into a signal, is affected by the target when it's detected and there are some non-intuitive properties when it comes to low-power optimisation.

When power is saved the signal-to-noise ratio (SNR) will ultimately cause problems and determine the detection limit and how far it is possible to go. SNR is the property that is turned into resolution and in general terms the detection limit can be expressed as: (see below)

Author details:
Henrik Rödjegård is CTO, Senseair and Staffan Ehde Creative Director, Senseair, Asahi Kasei

$$\text{Detection limit} = \frac{\text{Measurement noise}}{\text{Optical signal} \times \text{Sensitivity}} = \frac{\text{Detector noise}}{\sqrt{\text{Duty cycle}}} \times \frac{1}{\text{Input power} \times \eta_{\text{source}} \times \eta_{\text{optical}} \times \text{Sensitivity}}$$

The sensitivity is determined by the spectroscopy and is normally not possible to adjust in order to save power, without sacrificing the measurement range. The efficiency of the light source is noted as η_{source} , and the total optical efficiency, including collimators and reflection losses, is noted as $\eta_{optical}$.

The duty cycle is the first parameter you adjust when optimising for low power. Since it scales as the square root it is a powerful tool for reducing power without losing too much resolution.

Assume that you adjust the on-time of the lamp from 100ms per second (Duty cycle=10%) to 100ms per 10 seconds (Duty cycle =1%), then you can gain an average power reduction of 10 times at the cost of $\sqrt{10} = 3.2$ times reduction of the resolution.

On the other hand, it is expensive to compensate for low resolution by increasing the duty cycle. A 10 times increased resolution will need 100 times increased power, if it's obtained by an increased duty cycle.

Another way to save power would be to reduce the input power to the light source during on-time. However, the SNR scales linearly with the power reduction, which is less favourable than saving the same power by a duty cycle reduction.

From a system point of view, it is most power efficient to maximise the input power and reduce the duty cycle.

Assume that you can push 10 times more power into the light source and get 10 times more light out. That increased peak power will allow you to reduce the duty cycle 100 times and reduce the total power consumption 10 times with maintained resolution.

Light source efficiency is not the only parameter that determines the system's power consumption. The peak power of the light source is equally important. Until recently, this was the weak spot when high



efficiency LEDs were used in NDIR sensors. The low power of LEDs results in either bad resolution or increased power consumption.

Lamp to LED technology

This has essentially been a Catch 22, where low power LED technology cannot be used since the total overall power will increase. In order to manage the transition you need to look at Equation 1.

A low power source can only be compensated by reduced detector noise and/or improved optical efficiency.

First, modern room temperature IR photo diodes provide 8 times better SNR when compared to traditional thermopile sensors, allowing for either a weaker, but more efficient, light source or a 64 times reduction of the duty cycle.

This was the breakthrough that led to the first low power NDIR CO₂-sensor with performance comparable to traditional sensors.

The Senseair LP8 uses 0.7mW and while it has an incandescent lamp it takes advantage of a high-resolution photo detector. The

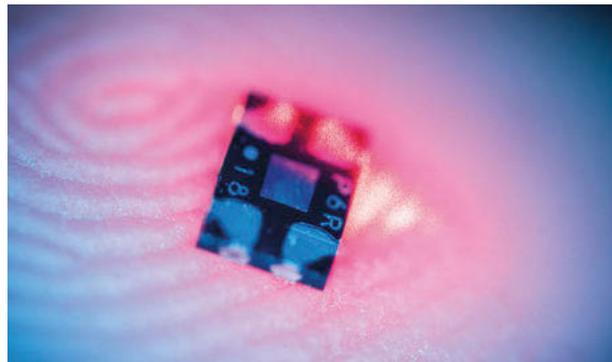


Figure 2: A comparison of NDIR sensors in the last 30 years, from a traditional lamp to the latest micro devices

Figure 3: A modern IR photo diode from AKM operating at room temperature

drawback here is obvious - at these low duty-cycles - the slow response of the filament.

The duty-cycle cannot be handled by reducing the on-time and with long off-times you will end up getting long intervals between each sample, and so there is a risk of missing events and adding a time lag to observations.

Another weak spot with lamps is poorly defined geometry, where the radiating filament is spread out in a space over several millimetres and positioned with tolerances of about ± 0.5 mm.

Using miniaturised optics, it is not possible to collect and collimate the light from the lamp with high efficiency. An LED, on the other hand, has a small but well defined emitting area that can be positioned with accuracy better than 0.1mm.

The Senseair Sunrise has been developed for the accurate positioning of the LED, resulting in an optical efficiency of 30%. This can be compared to the 3% efficiency of a classical NDIR sensor such as the Senseair S8 or LP8.

The Sunrise uses 0.5mW power on average, in spite of the relatively weak light source, thanks to the improved optical efficiency.

By improving the detector SNR and optical efficiency there is room for an 80 times reduction of light power with maintained resolution - sufficient to allow for a transition to LED technology.

Since both detectors and emitters are based on solid state technology there is no practical speed limitation, meaning that you can get valid readings as often as you want with a maintained low duty cycle.

It is not obvious that high efficiency components will result in low total power consumption. For some sensors, like older NDIR gas sensors, a more efficient light source with low output power will often result in higher power consumption of the total system.

Control your lighting

Intelligent lighting but without the disruption, cost and maintenance associated with hard-wired installations. By **Saima Shafi**



Whilst the advantages of converting from fluorescent lighting to LED technology are substantial, they become far greater when integrated with an intelligent lighting control system, which delivers the correct amount of light where and when it is needed. When dimmed, LED lighting becomes more energy efficient and automated systems, like daylight harvesting and occupancy sensors, can turn on or dim lights according to changes in light or need.

Wireless lighting control systems, however, are designed to control lighting without the need for complex wiring systems and provide increased flexibility in the way an area of a building can be used. Instead of positioning switches and sensors where wiring permits, building operators can place controls where they are needed with ease to optimise lighting performance.

Automated lighting networks can radically reduce energy consumption whilst delivering optimal lighting performance, where it is needed. Typical savings, when combined

with LED luminaires are between 60-95%, depending on its application – ranging from commercial to industrial, education to healthcare and hospitality. In addition to the obvious energy savings, an intelligent lighting system allows activation of an individual light or groups of lights from one device, sets lights to turn on and off or dim at precise times and creates customised lighting for a specific task.

A wirelessly connected system eliminates the disruption, cost and maintenance burden of hard-wired installations, whilst still allowing full control of the lighting system. The resulting system is at heart simple - yet infinitely scalable to the needs of the installation. From a single light fixture to thousands, within the same system, there is no upper limit.

New solutions like Light Boss make lighting networks much easier to design as well as install and maintain. Software enables users to upload their floorplan – existing or proposed - for quick lighting layout creation, via easy-to-use 'drag and drop' tools. Once installed, the connected system

Above: The benefits of LED lighting are enhanced with an intelligent lighting control system

creates a digital network, where luminaires communicate wirelessly, controlled by Android app or web interface, with simple software.

Setting or adjusting the lighting can be achieved without any wiring changes. Luminaires can be added or replaced, and re-configured at the touch of a button and without any expensive re-commissioning.

Monitoring & maintenance

An extensive status monitoring dashboard provides on-demand reports of the 'health' of LED sources and drivers, highlighting any critical failure points that need attention.

For those involved in providing lighting support to sites, for example facility managers, the solution caters for 'active' maintenance support, in addition to delivering 'reactive' lighting maintenance solutions fast and effectively. Neither of these functions require maintenance teams to carry out surveys or make visits to the relevant site.

In addition to its routine maintenance capabilities, an intelligent lighting control system provides automation of routine emergency light testing and maintenance requirements, for example with self-test features for emergency lighting. Without the need to attend site and test individual light fittings, users are alerted to faults as and when they occur. With logging and fault recording functionality, it eliminates the need for manual recording.

Reporting on the energy consumption of all connected lighting fixtures allows analysis and measurement of a single site, or all the sites being managed. This makes a wirelessly connected system ideal for reviewing the energy performance of multi-site portfolios. Energy and facility managers can log in to review data from any site location as little or as often as needed.

A major advance of this integrated solution is that it can be applied to new builds, retrofits, old and new lighting.

Author details:
Saima Shafi, Sales and Marketing Director, Light Boss

Go Green without risk

Energy savings and reduced carbon footprint are compelling reasons for businesses to transition to LED lighting. But an uncertain economic climate can see risk-averse companies kicking the can down the road.

LEDs provide better working environments than traditional lamps and LED-lit workplaces are healthier, safer and more productive. Retrofit options give buildings a better quality of light without disruption and all fittings are easily upgradable, enabling them to be added to building automation systems.

It is not only the working environment that benefits - finances are healthier, too. The energy-savings and carbon footprint are obvious advantages, while the business gains a corresponding reduction in its carbon footprint.

Cost savings extend well beyond the improvement in power consumption. A substantial contribution comes from lower maintenance requirements. Although the initial cost is higher, the longevity of LED lighting more than compensates. When it comes to lifetime costs the cost of removing spent lamps, disposing of the old units and fitting replacements can be huge. Where quality LED lighting manufacturers offer guarantees of five years, maintenance costs can be eliminated altogether.

Many organisations have still not converted from incandescent, halogen or compact fluorescent lamps because of the high initial cost of installing LED lighting. It is possible to lease LED lighting through monthly energy savings.

Unlike conventional bank lending, either unsecured or tied into some form of collateral, leased assets are a form of collateral by themselves. Both parties are exposed to significantly lower risk, so leasing decisions can quickly respond to immediate commercial requirements.

Leasing also enables businesses to fund lighting replacement programmes from their operating budgets. Some leasing schemes allow the replacement LED lighting to be paid-for directly from energy savings. Companies can fund LED lighting completely out of their reduced energy costs and, depending on the length of the agreement, rates can be fixed for two to five years removing uncertainty and making budgeting easier.

Leasing is also tax friendly, with fixed monthly costs 100% allowable under UK taxation rules and with fixed rate schemes the risk is further reduced because the manufacturer's guarantee covers the lighting units throughout the term of the lease. When the lease finishes, the customer will own the lights outright and is still able to take advantage of remaining guarantee period. LEDs will continue to save the company money for years after the lease period.

There are further advantages to funding a lighting replacement programme through the manufacturer's lease offering. With the Bright Plan from Goodlight, for example, businesses get a free site survey which provides a detailed breakdown of suitable replacement light fittings, the installed cost and the return on investment from savings on energy and maintenance costs. They also guarantee all LED fittings for 50,000 hours, making each LED lighting installation risk-free.

Light Boss modules are connected during the LED lighting upgrade, saving the time and costs of an additional lighting control installation.

Because the technology can be retrofitted – any luminaire and even individual lamps can be replaced with new LED and wireless-enabled luminaires. Integrate with non-LED luminaires, to also make them smart aswell. All data can be monitored via the Android App (or via a web interface) or downloaded for easy analysis.

The savings can be substantial. Operating your lighting where it is needed – rather than at 100% brightness constantly – not only minimises energy consumption, but

Below: A monitoring dashboard provides on demand 'health' reports on LED sources and drives



also extends lighting lifecycles and reduces maintenance costs. Example cost savings for a distribution centre fitted with LED lighting and Light Boss are around 87% with a payback of less than two years.

What is more, a wirelessly connected system qualifies for government schemes such as the Carbon Trust Green Business Fund. By claiming 100% first year capital allowance, through the Enhanced Capital Allowances Scheme (ECA), installers can offset the cost of a Wireless LED lighting control, LED luminaires, and their installation.

Lighting control systems are an effective way to reduce energy and operating costs. However, hard-wired systems can be expensive and time consuming to install, particularly in existing buildings, so it's no wonder that wireless technology continues to gain popularity for building operators.

CASH POSITIVE	FIXED COST	TAX SMART	FLEXIBLE TERMS	REDUCE CO2	FUTURE PROOF	RISK FREE
No money upfront. Your monthly leasing cost will be covered by your energy savings with extra left over for your business, every month.	Fixed rates for the length of the agreement, making budgeting easier. Choose from 2, 3, 4 or 5 Year options.	Bright Plan offers major tax advantages. Every payment is 100% allowable against tax.	Our terms are totally flexible and are better than current bank rates. Choose from 2 to 5 year terms.	Meet government targets and enjoy the positive PR of reducing your carbon footprint, all while doing your bit for the environment.	You own the lighting outright at the end of the term*, and our ultra long-life LED lights will save your company money for many more years ahead.†	Our 5 Year Guarantee covers the entire lease term. If any lamps fail, we will provide a replacement free of charge.
<small>*Subject to nominal charge. All credit is strictly subject to status. † If a Goodlight™ LED light is on for 24 hours a day, it is rated for 5.5 years, 12 hours a day: 11 years, 6 hours a day: 22 years.</small>						

Automation remodels the distribution landscape

Despite set-backs in the economy, the distribution market remain positive, and is seeing the benefits of automation to increase efficiency, reports **Alex Brinkley**

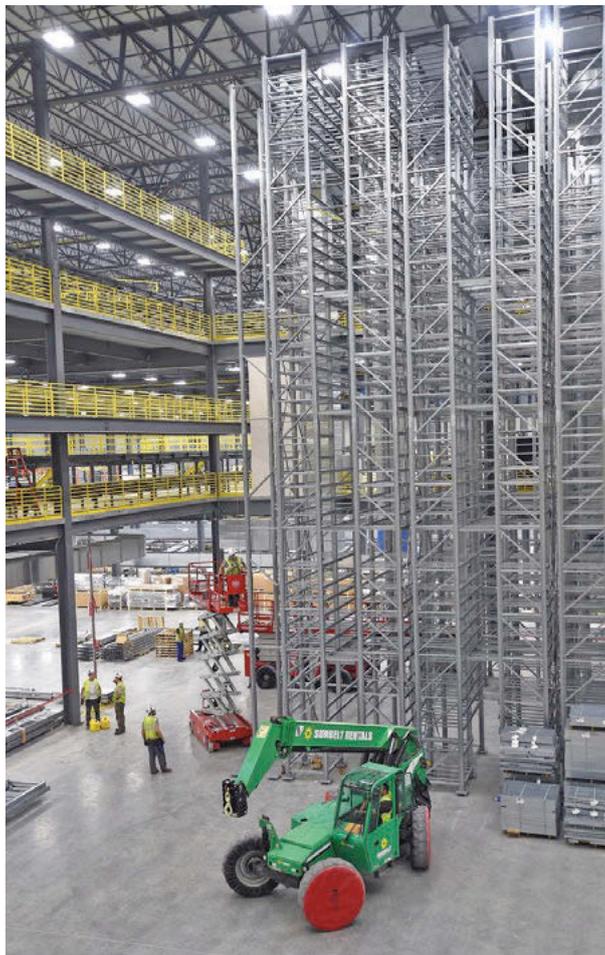
Two years ago, the electronics distribution market was in an optimistic and positive mood. There were significant investments made for premises expansion plans by some of the leading distributors, coupled with investments in automation to accelerate the process. One of the spurs for this activity was a recovery in electronics manufacturing but also the interest and activity generated by the Internet of Things (IoT). Forecasts for the IoT market jumped from 2013 estimates of 30 billion connected devices by 2020 to 2018's figures of one trillion by 2035.

In 2020, the corona virus, Covid-19, has spread around the world. This has seriously affected production of the sensors, thermostats and processors used for connected networks, as well as PCBs, capacitors, relays and other electronics components.

Expansion plans

Despite the present pandemic, building work and extension plans continue. In north Minnesota, USA, Digi-Key Electronics is expanding its distribution centre to double capacity with a building project that will add 2.2 million sq ft (approximately 204,390 sq m) to its Thief River Falls facility. The new Product Distribution Center is scheduled to open in Q3, 2021. It is well served by road links and is just north of Thief River Falls regional airport, where parts are delivered to UPS and FedEx hubs in the US for onward delivery.

The new premises will be largely automated, said Digi-Key's Brian



DeHaan, Director of Engineering, "We will receive an advance shipment notification (ASN) such that we'll know which products are coming in the door every day on every truck. We'll use that data to automatically receive some of the product as it comes off the truck and we'll verify it. It'll be completely automated through a barcode reading station or scan tunnel to receive product with zero touch from a human," he added.

Above: Digi-Key's new distribution facility is set to open in 2021

Sometimes boxes will need to be opened to verify contents and made for picking, he conceded but picking will mostly be automated. Approximately 98% of picks will be stored in an automated storage system, with the trays delivered to the picking staff. The other 2% will be picked manually.

In the future, picking will be automated further. "Given Digi-Key's breadth [the company has 2.2 million SKUs] it's a challenge to automate picking but we are looking into robotic picking technology," said DeHaan.

"We're implementing a new warehouse management software system that will give us more visibility to inventory breadth and depth, date lot codes, quantities, etc. We are also partnering with our automation supplier, which has software that will bring the right product to the order picker, essentially providing inventory control," he added.

Packing is manual, although the company is looking into more pre-packing of products that are commonly purchased in quantities, for example packs of 10, 15, 20, 25, for accuracy and efficiency.

The shipping operation will be automated at the PDC. "We have a ship sorter which automatically weighs, determines dimensions and sorts, based on the carrier," said DeHaan.

The facility has been designed for a fleet of autonomous vehicles and DeHaan confirmed it is planning to use autonomous vehicles "to deliver supplies and interoffice mail, cleaning, etc".

European automation

Canadian distributor, Future Electronics chose Leipzig, Germany as its distribution centre. Its position in Saxony and road infrastructure means that most of Europe is accessible within a day's drive.

Amir Wagenstein is vice president of operations for Future Electronics, EMEA. He set up the 15,000 sq m which officially opened in 2010. It combines a warehouse management system and transportation management system to co-ordinate and dispatch 4,000 lines (orders made up of single or multiple products) each day.

It is fully automated, said Wagenstein, with products stored in totes and delivered by a network of conveyors, automatic trays and trollies to staff at picking stations. It is here that human intervention is used to extract four reels of components from five in the tote, for example, according to the order details displayed on a screen at the picking station. The human touch also helps with customised orders: "There is no minimum packaging quantity (MPQ)," said Wagenstein.

The rest of the process is automated, with goods sent to the dispatch area when packed where they are labelled before delivery by road or air.

Compared to the manual warehouse which operated in the

UK until the company relocated, productivity has improved five to 10 times at Leipzig, Wagenstein said.

At the same time, the company has reduced from three to two day shifts. The automation has also improved quality, with less errors and created a quiet workplace as most of the activity (and noise) is in the "dark warehouse". This occupies around two thirds of the site and consists of hundreds of metres of aisles, holding 250,000 totes of products which are released by management system to a designated packing station.

The majority of goods are delivered by road, primarily. It is no coincidence that the facility is just 15 minutes' drive from DHL's largest hub in Europe. The site is close to central and western Europe, where most of the electronics market is, explains Wagenstein, and also close to the emerging markets in eastern Europe and Russia.

The goal will be "dock-to-stock" automation, says Wagenstein. Today, staff inspect goods for quality as it requires a human to identify any discrepancies or to accommodate bulky parcels.

Automating delivery

All distributors place an emphasis on transport links, but could this be an out-moded business model as automated delivery grows?

A report by Lux Research,



Above: Delivery drones are to have a bigger role in logistics (Credit: UPS)

Automating the Last Mile, predicts that automated parcel deliveries that cover the last leg of the journey will account for 20% of parcel deliveries by 2030.

In 2019, drones, robots with wheels or legs and autonomous vehicles delivered 107 billion parcels to consumers and generated \$350bn in revenue. The research company believes this will more than double by 2030 to 289bn parcel deliveries and revenue of \$665bn – a CAGR of 9.5% in parcel numbers.

It is something that Wagenstein can see becoming part of the business model in time. "As the digital platform has become more popular - we see the online business for retail and food is more powerful - I expect it to become much more advanced for electronics purchasing, for small quantities. I can also see the logistics providers, the couriers and freight forwarders considering the drone element within the next few years," he said.

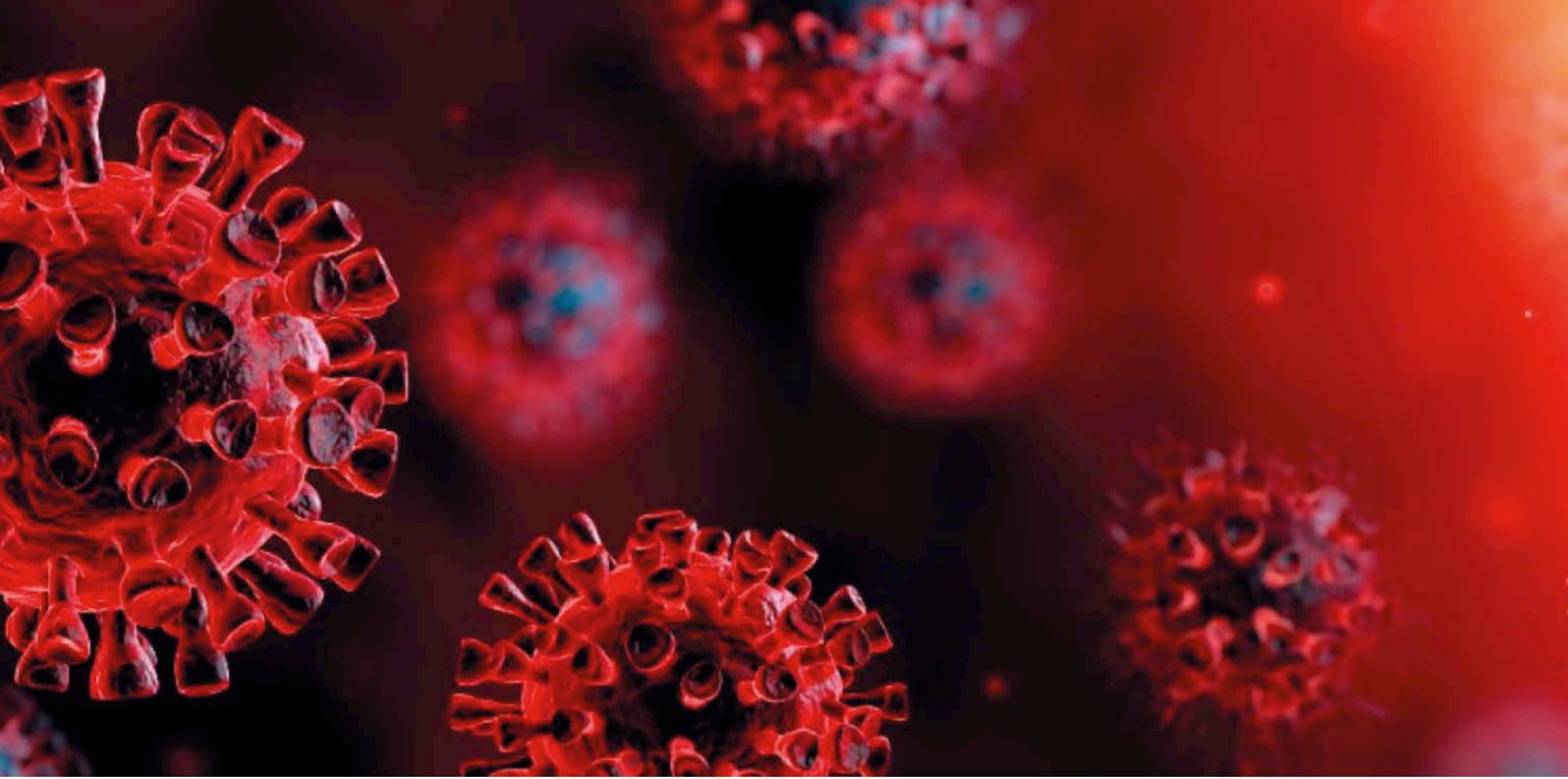
The German company, Wingcopter which makes drones, has partnered with UPS Flight Forward (UPSFF), the carrier's drone delivery subsidiary, to build a fleet of drones for commercial deliveries in the US.

The electric-powered Wingcopter has vertical take-off and landing for use in confined spaces. It can switch between multicopter mode, for hovering, and fixed-wing mode, for low-noise, forward flight and has a range of up to 120km (75 miles) and up to 240km/hr (150mph).

Subject to approval, UPSFF aims to expand the use of delivery drones beyond healthcare and retail to "solve long-standing challenges" for high-tech and industrial manufacturing.

Below: An interior shot of Future's facility in Leipzig





A CYBER APPROACH TO CORONAVIRUS CONTAINMENT

What lessons can be learned from reviewing how we manage cybersecurity and applying it to an anti-Coronavirus campaign? By **Zohar Rozenberg**

In recent years, some in the cyber world recognise that there is a lot to learn from the biological world when protecting systems against viruses. Now, the Corona epidemic presents an opportunity for the medical world to learn something from the cyber world.

Cybersecurity is built in layers and there is no one magic solution or layer which will prevent all possible attacks. Furthermore, in the cyber world, it has been realised that it is impossible to protect everything for all eternity. There will be victims. Computers will be attacked, information will be stolen, and activity will be interrupted. It has already been accepted in the business world that it is not possible to maintain an extremely high level of protection, while at the same time enabling a business to run at its required pace.

A compromise must always be found, and risks managed. Extremely high levels of security are possible, but this will give rise to a situation where work may grind to a halt.

Businesses accept that by running freely, they expose themselves to various levels of cyber threats.

The challenge, which has become the main responsibility of information security managers, is to learn how to live with these day-to-day compromises. To understand the risks they take, determine what level of risk they can accept, and what level of risk is too great.

Just as businesses weigh various protection approaches, we can see several strategies for protection against Coronavirus being implemented by various countries. In Asia, South Korea, and Taiwan, relatively advanced approaches have been adopted in detecting the threat, finding where it is harboured, and dealing with it surgically wherever identified. All this is in conjunction with a basic layer of disinfecting large areas.

As in the cyber world, this can be seen in the use of advanced concepts of threat hunting and extensive

investment in detection and incident responses. All this is above and beyond the basic layer of a standard firewall and endpoint protection in order to provide some basic level of protection throughout the whole organisation. This approach is a reflection of an understanding that the “point of contact” to the world will be breached, or in the professional slang, “the perimeter is dead”. It is not possible to achieve full protection and keep the threat outside the perimeter forever. The threat must be sought out on a targeted basis and dealt with wherever identified without giving up on a basic layer of protection, which will succeed anyway in preventing the simpler threats from penetrating.

Traditional approaches

Aside from these countries, most countries in the world, including Israel, Italy, and the USA have adopted approaches that are considered more traditional, according to the cyber world. Israel began with an approach

that derives from the belief that there is indeed a “perimeter” and that the threat can be blocked externally and prevented from getting inside - this approach is now widely thought to be inherently irrelevant.

Subsequently, Israel, like Italy and the USA, transitioned to taking a more aggressive policy. In the cyber world, such an approach equates to a policy of a strong lock-down of the network, preventing the transmission of information between points in the network.

This makes any approach to the resources of the network difficult and attempts to reduce traffic on the network. Such an approach can indeed succeed in producing achievements in terms of preventing breaches of the network and the endpoints, but it also has the effect of preventing most of the activity on the network and, consequently, having an adverse effect on the organisation’s business activity.

Such an approach to protection was previously beneficial at sensitive locations such as Defense Establishment Institutions, but over the years, they have also understood that it is impossible to operate over time with such difficulties piling up over the activity of the organisation.

Throughout the industry, it is now difficult to find organisations that still stick with the approach of a robust and aggressive cyber policy. In the last decade, we have witnessed a shift towards more considered risk management, which attempts to strike a balance between the need to facilitate activity and the desire for protection.

Initially, Britain attempted to adopt its own unique approach and attempted to rely upon the immunity of all its citizens. In cyber terms, it was as if they were content with the installation of anti-virus software at all the endpoints. This approach has not been relevant in the cyber world for approximately 20 years, and no organisations would look to use it

as their approach for protection, with the possible exception of very small businesses.

Threat intelligence

It is possible to analyse the operational approaches of the countries from another angle in the cyber world, and that is “threat intelligence”. On one side of the spectrum is the USA, which appears to have approached this situation with a profound lack of information, to the point of ignorance in the face of the threat. On the other hand, Israel has learned as much as it could about the threat and has attempted to prepare for it ahead of time.

Today in the cyber world, there is a growing acknowledgment of how difficult it is to build a layer of protection against cyber threats without engaging in the acquisition of advanced information related to threats and their nature. Currently, leading organisations are widely reliant upon information when addressing cyber threats.

Another analogy to the cyber world can be analysed from the public reactions in various countries. Apparently, in Singapore, Taiwan, South Korea, and perhaps other places, the public has strictly complied with governmental directives, understanding the risk and responding well to the threat. On the other end of the spectrum is Italy, which reacted complacently, did not heed governmental instructions, and didn’t understand the size of the threat to begin with.

Thus, in cyber, the sphere of awareness and training which has been gathering momentum in recent years tries to get the personnel of the organisation to appreciate the threat and educate them on proper procedures in the presence of a threat. This is regarded as maintaining “cyber hygiene,” which reminds employees not to open suspicious emails, how to report something suspicious to the organisation.



“Cybersecurity is built in layers and there is no one magic solution or layer which will prevent all possible attacks.”
Zohar Rozenberg

Organisations that have invested in educating people regarding awareness and correct actions have reported an improvement in the immunity of the organisation to cyber threats.

It appears that in the cyber world, more advanced organisations are adopting more innovative approaches, and the use of advanced tools such as threat hunting, detection, incident response, as well as employee awareness have produced better results in coping with cyber threats. Thus, in the physical world, countries that have adopted similar approaches appear to have succeeded, at least for now, in containing the virus’s threat in terms of a dramatic reduction in the number of cases of infection and are on the point of at least a partial return to routine. Countries viewed as maintaining more traditional approaches and attempting to sanctify the perimeter or apply tough, aggressive policies as their major effort, are finding it very difficult to contain the threat. These countries are still seeing a rise in cases, coupled with a widespread paralysis of economic activity.

If countries wish to learn lessons from the world of cyber protection in order to deal with the Coronavirus threat, then they must bear in mind that building defences must consist of several layers. No one method can avoid the threat.

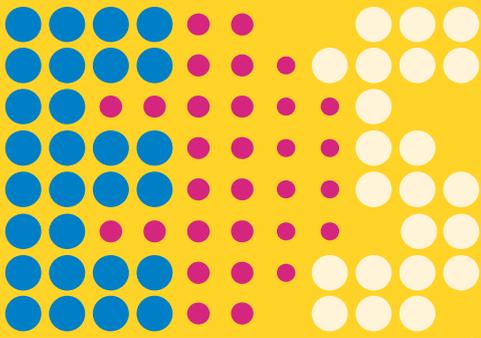
Investment efforts must be put toward prevention. It is essential to create a basic level of control and monitoring of entrances, but the action is also necessary on the level of detection and treatment.

This can only be done properly by adequately gathering and analysing the latest data.

It is to be hoped that more and more countries will consider adopting more advanced protection approaches, finding ways of applying them in the physical world in order to accelerate the end of the threat and bring about a return to a normal routine.

Author details

Zohar Rozenberg is VP of Cyber Investments for Elron, investing in early-stage cybersecurity and Enterprise software start-ups.



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