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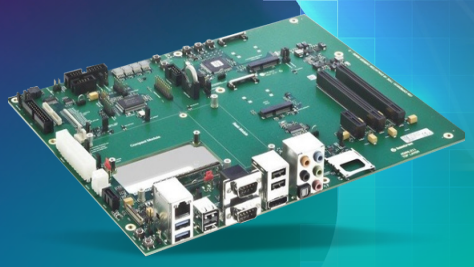

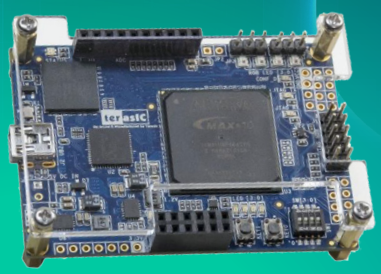

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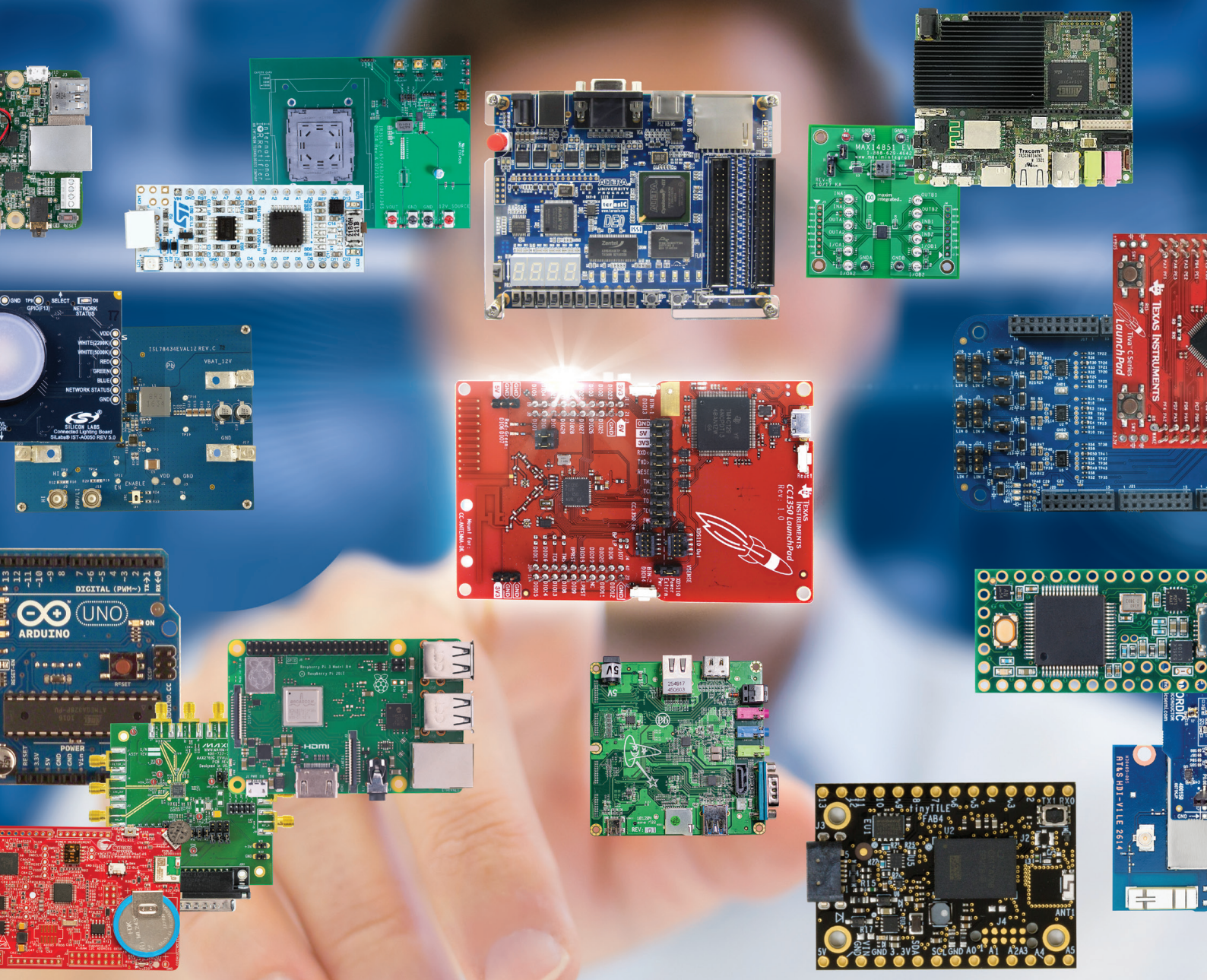

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In this issue...

Artificial Intelligence – in one guise or other – is all around us. We reflect this in a bumper February issue with articles entitled: 'Optimizing control and design for industrial robotics', 'The Edge of Embedded', 'Technology that speaks the same language' and 'Making sense of sounds: boost machine uptime'. Our industry news round-up reports on: the first all-digital road-noise cancellation; ST joining the Zigbee Alliance board; reducing inverter cost using SiC; and Intel's new chairman.

Plus, of course, regulars: Dev Kit Pick, Tech Tips, Mouser Q&A and the latest, most innovative NPIs now in stock at Mouser. Now read on...

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Analog Devices and Hyundai® to create all-digital road-noise cancellation system

Enabling higher levels of functionality in automotive systems involves more than just adding things under the hood. Integrating advanced capabilities with vehicle infotainment, Analog Devices has announced a strategic collaboration with Hyundai Motor Company, where Hyundai® plans to launch the automotive industry's first all-digital road noise cancellation system. The solution will leverage ADI's Automotive Audio Bus (A²B) technology, which Hyundai also intends to more broadly adopt for fundamental audio connectivity and infotainment applications across its automotive fleet.

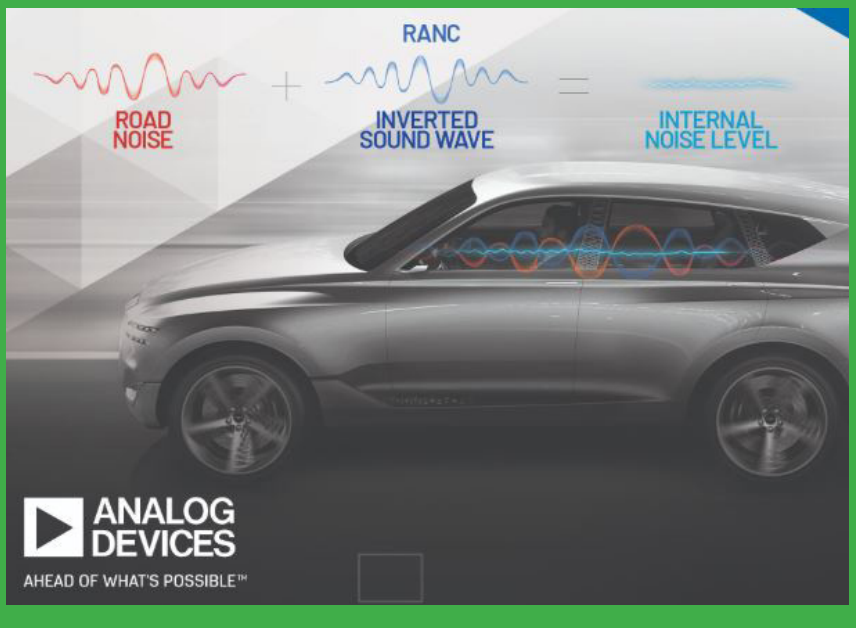
"As an early A²B adopter, we realized the potential of this technology for not only our Road-noise Active Noise Control (RANC) systems but also for other vehicle applications fundamental to passenger and driver experience," said Dr. Kang-Duck Ih, Research Fellow, Hyundai. "The low latency guaranteed by A²B enabled us to implement this groundbreaking RANC technology and accelerate its deployment to mass production."

Hyundai's RANC system dramatically reduces noise within the cabin of a vehicle, by analyzing various types of noise in real-time, and producing inverted soundwaves to cancel them. For example, there are different types of road noises that the sound-management technology can process, such as resonance or rumble sounds created between the tires and road.

"We have collaborated closely with Hyundai to architect its all-digital RANC system that leverages our A²B technology to reduce equipment cost, weight, and design complexity, and in turn, improve overall fuel efficiency – helping solve several challenges of the electronic RANC system," said Patrick Morgan, Vice President, Automotive Electrification and Infotainment, Analog Devices. "ADI's work with Hyundai demonstrates A²B's increasing viability and further distinguishes Hyundai's vehicles in today's marketplace."

A²B reduces cabling weight by up to 75 percent, improves automotive fuel efficiency as well as total system costs, and is the industry's lowest latency, high-speed digital interconnect technology distributing audio and control data together with clock and power over a single, unshielded twisted-pair wire. ADI's A²B technology significantly reduces associated wiring harness cost and complexity found in traditional analog-based road noise cancellation system deployments.

www.analog.com/a2b
www.hyundaimotorgroup.com



Swissbit Opens production facility in Berlin

Swissbit, a specialist provider of data-storage and security solutions for industrial applications and the Internet of Things (IoT), announced the official opening of its new state-of-the-art electronics production facility in Berlin, Germany. Secretary of State, Dr. Frank Nägele, took part in the reception at the high-tech factory in the CleanTech Business Park in Berlin-Marzahn. Swissbit is set to increase the number of jobs in development and production from 200 to up to 300 by 2023.

Taking just over a year to construct, the factory has been in operation since October 2019 with complex precision manufacturing of the latest memory and security modules for industrial use. Swissbit is ideally positioned for growth markets, supplying the latest generation flash memory solutions and innovative security products for embedded IoT applications, including memory modules with integrated chips for authentication and data encryption.

Increased networking of devices in the Internet of Things is seeing a dramatic rise in the requirements for the protection of data and devices and thus the demand for smart security products for embedded IoT solutions. Counterfeit protection for cash registers, which will be mandatory in Germany from 2020, is one of the application areas of the new Swissbit solution.

According to Silvio Muschter, CEO of Swissbit, "Swissbit products have always been and will remain 'Made in Germany'. Our plant in Berlin has it all: skilled developers, proven experience and the latest equipment. We're excited to be close to an important developer and start-up scene and thrive on the cooperation opportunities with local research and educational institutions that the location offers."

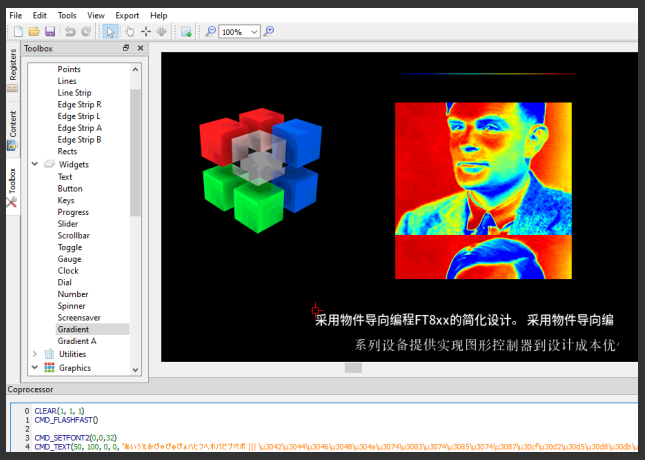
www.swissbit.com

Bridgetek's EVE toolchain to support for 3rd-party hardware

Further extending the operational parameters of the ecosystem that accompanies its award-winning Embedded Video Engine (EVE) graphic controllers, Bridgetek has announced the release of an improved version of EVE Screen Editor (ESE). Relying on simple drag-and-drop actions, ESE 3.3 is the latest update to the company's intuitive Windows-based tool, intended to assist engineers in expediting advanced level HMI construction, without requiring any prior expertise in that area.

Through its use, engineers can optimise their HMI layout and create detailed display lists. They can also evaluate the effectiveness of their HMI and make alterations, as well as experimenting with different design concepts and configurations. The improved version of ESE is able to connect to numerous items of external hardware, such as the VM800, VM816 and ME81x HMI development platforms. In addition, the device sync feature enables the latest generation of third party EVE display modules from Bridgetek partner Riverdi to be supported.

The solution enables a greater breadth of example projects to be accessed, including ones relating to functions like the Blend_Func and the circular progress bar widget.



For greater convenience, ESE 3.3 allows either horizontal or vertical movements to be accurately charted (with XY coordinates given). The user can also constrain an object's movement along one axis when it is being dragging (for precision placement). Through the analytical features incorporated, engineers can check a given pixel's value on the status bar (by hovering the mouse over the viewport window).

www.brtchip.com

HARTING and Expleo Group to Cooperate on Industrial IoT Solutions

Recently the HARTING Technology Group and Expleo reaffirmed their long-term cooperation in the area of data-controlled services and IoT solutions for industrial customers. The agreement was signed by Philip Harting, Chairman of the Board of the HARTING Technology Group, and Peter Seidenschwang, Head of Industry at Expleo Germany.

In the cooperative effort, HARTING is offering its modular edge-computing MICA, which has been designed according to industrial standards for multiple industrial applications, and Expleo is contributing its know-how in connectivity and data-science competence. Expleo has been involved in the MICA network since 2016, working on the development of a solution for the process and operational optimization of machines and production systems.

The SmartANIMO application from Expleo learns the standard behaviour of connected production lines and individual machines, and identifies deviations in the process without manual intervention. The robustness and flexibility of MICA also enables Expleo to implement the solution in industrial environments and to retrofit existing production systems non-invasive.

www.harting.com

Intel elects new Chairman

Intel® announced that Andy D. Bryant stepped down as chairman and the board elected lead independent director Dr. Omar Ishrak to succeed Bryant as an independent chairman, effective immediately. Intel also announced that Alyssa Henry was elected to Intel's board. Her election marks the seventh new independent director added to Intel's board since the beginning of 2016.

Bryant will remain on the board through the end of Intel's 2020 annual stockholders' meeting. He had previously notified the board in March 2019 that he did not intend to stand for re-election at this year's meeting. Bryant made the decision to leave the role now in order to facilitate an effective transition.

"I want to thank and congratulate Andy for over seven years' service as chairman of the board," said Intel CEO Bob Swan. "Andy has been a rudder for Intel during a time of change and transformation. He has led the board with integrity and always with Intel's best interest in mind."

"It has been my great honour to serve as Intel chairman, and I plan to retire from the board in May with great optimism about Intel's future," Bryant said. "I have full confidence in Omar leading the board, which is fortunate to have his expertise at leading an innovative, global company. In addition, Alyssa's wealth of senior leadership, cloud computing and emerging technologies experience further strengthens Intel's board."

www.intel.com

From left: In January 2020, Andy Bryant transitioned from chairman of the Intel Corporation board of directors to a member of the board and executive advisor to the company, Dr. Omar Ishrak was named chairman of the board, and Alyssa Henry joined the board.

TI - Texas Instruments Jacinto 7 processors to enable ADAS and Gateway tech

Advanced vehicle features and capabilities require next-generation automotive-grade solutions. Addressing the need for improved systems, Texas Instruments recently introduced the Jacinto 7 processor platform, which brings enhanced deep learning capabilities and advanced networking to solve design challenges in Advanced Driver Assistance Systems (ADAS) and automotive gateway applications.

The first two automotive devices in the platform, TDA4VM processors for ADAS and DRA829V processors for gateway systems, include specialized on-chip accelerators to segment and expedite data-intensive tasks, like computer vision and deep learning. Additionally, TDA4VM and DRA829V processors incorporate a functional safety microcontroller, making it possible for original equipment manufacturers (OEMs) and Tier-1 suppliers to support both ASIL-D safety-critical tasks and convenience features with one chip.

TI's new processors execute high-performance ADAS operations using just 5W to 20W of power, eliminating the need for active cooling. The TDA4VM processor offers on-chip analytics combined with sensor pre-processing, enabling more efficient system performance. This allows OEMs and Tier-1 suppliers to support front camera applications using high-resolution 8-MP cameras to see farther and add enhanced features, such as drive assist. Additionally, TDA4VM processors are capable of simultaneously operating four to six 3MP cameras while also fusing other sensing modalities such as radar, LIDAR and ultrasonic on one chip.

This multilevel capability enables TDA4VM to act as the centralized processor for ADAS and enables the critical features for automated parking, like surround view and image processing for displays, enhancing vehicle perception for 360° of awareness.

The DRA829V processor seamlessly integrates the computing functions required for modern vehicles. As vehicle technology advances, automotive gateways need a flexible processor to manage higher volumes of data and support evolving requirements for autonomy and enhanced connectivity.

The DRA829V processor is the first in the industry to incorporate a PCIe switch on-chip in addition to integrating an eight-port gigabit TSN-enabled Ethernet switch for faster high-performance computing functions and communications throughout the car.

Developers can get started immediately with Jacinto 7 processors development kits, and buy the TDA4VMXEVM and DRA829VXEVM evaluation modules on TI.com for US$1,900 each. Preproduction TDA4VM and DRA8329V processors are available now, only from TI, at US$97 in 1,000-unit quantities. Volume production is expected to be available in the second half of 2020.

www.TI.com

SMA and Infineon to reduce inverter cost

With the installed photovoltaic capacity growing rapidly worldwide, supplying clean and cost-effective electricity, SMA Solar Technology and Infineon Technologies are supporting this growth trend by providing the latest generation of silicon carbide (SiC)-based solar inverters.
With the Sunny Highpower PEAK3 from SMA, available since 2019, decentralized photovoltaic power plants can be planned flexibly and efficiently up to the megawatt range.

The basis for this is the compact design for 1500V_{DC}, which delivers an output of 150kW per unit. This is made possible by SiC technology from Infineon: Six power modules of the type CoolSiC EasyPACK 2B and 36 gate drivers of the EiceDRIVER family 1ED20 convert the direct current generated by the solar cells into grid-compatible alternating current - with an efficiency of over 99 percent.

"Silicon carbide enables us to build the inverters compact, powerful and reliable," said Sven Bremicker, Head of Technology Development Center at SMA. "In the Sunny Highpower PEAK3, the CoolSiC modules almost double the specific output from 0.97kW/kg to 1.76kW/kg. Due to the compact design, the inverters are much easier to transport and much faster to install."

"SiC-based power semiconductors are more expensive than silicon solutions," said Dr. Peter Wawer, President of the Industrial Power Control Division of Infineon. "But thanks to the electrical properties of the material, this is more than offset at system level. Higher switching speeds and efficiency allow transformers, capacitors, heat sinks and ultimately packages to be smaller – and thus save system costs." Infineon has developed a customer-specific solution for SMA that includes both a classic TRENCHSTOP IGBT and a CoolSiC MOSFET with body diode.

The ANPC (Active Neutral-Point Clamped) topology allows system voltages up to 1500V maximum to be switched with switches designed for 1200V. The topology thus uses the advantages of SiC, although only some of the switches in the EasyPACK module are based on it. Overall, the use of SiC reduces the complexity in the inverter. This not only increases efficiency, but also makes the system easier to maintain with an extended service life.

www.sma-uk.com

STMicro joins Zigbee® Alliance board

Among the many parts of the RF spectrum allocated for the various aspects of the Internet of Things (IoT), Zigbee® has been a mainstay of industrial systems since its inception. The Zigbee Alliance, an organization of hundreds of companies involved in creating, maintaining, and delivering open, global standards for the IoT, has announced that STMicroelectronics has joined its Board of Directors.

Along with other Zigbee Alliance promoter member companies, ST is set to play a vital role in the adoption and evolution of Zigbee, aiming to simplify development for manufacturers and increase device compatibility for consumers. According to Hakim Jaafar, Head of Marketing for Wireless Microcontrollers at STMicroelectronics, "As a leading and trusted Arm® Cortex®-M supplier committed to propagate Zigbee in its 2.4GHz product roadmap, ST has joined the board to share our expertise and help continue the Alliance's success."

With the evolution of connectivity and IoT markets, the STM32® MCU/MPU products include strong integrated security mechanisms to guarantee IP and privacy protection. ST's membership at the Zigbee Alliance Board of Directors aims to bring more visibility to the technology and accelerate new product developments with improved interoperability and cross-technology compatibility.

"STMicroelectronics plays an important role in powering next-generation IoT devices, and their leadership will be a great value-add at the board level and within working groups as we work diligently to create communication and connection standards that can be cast across continents," said Tobin Richardson, President and CEO, Zigbee Alliance. "As we head into 2020, it's extremely encouraging to see the impressive collection of global tech organizations like ST that are committed to cooperation and interested in taking a seat at the Alliance table."

www.zigbeealliance.org
www.connectedhomeip.com
www.st.com

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Industrial sensors ebook

In Industrial Sensing Solutions, leading experts from STMicroelectronics and Mouser offer detailed insights into the newest strategies for using industrial sensors, as well as the products empowering innovation on the factory floor. The ebook features multiple articles on advancements in MEMS technology, highlighting the critical roles these devices play in Industry 4.0.

While sensors have long been a fixture in industrial applications, their deployment has been slowed by issues relating to cost, size, and accuracy. Advances in compact MEMS technology have created new opportunities for sensor deployment in smart factories, while reduced cost and current consumption have improved the scalability of sensor solutions. The new ebook from ST and Mouser examines the technological advances achieved over the past decade, highlighting the many ways in which sensor suppliers have addressed customer demands.

Industrial Sensing Solutions features detailed information on several ST products, including the LSM6DSOX iNEMO inertial module and the ISM330DHCX iNEMO inertial SiP module, specifically tailored for Industry 4.0 applications.

These robust system-in-packages incorporate a 3-axis digital gyroscope and 3-axis digital accelerometer in a low-power solution with a machine-learning core. The machine-learning core, an ST innovation, is a power-saving feature that allows the sensor to recognize activities without having to wake the rest of the system.

The ebook includes convenient links and ordering information for nearly twenty sensor products offered by STMicroelectronics, as well as links to useful video content. STMicroelectronics' complete range of products, available from Mouser, includes sensors, development boards, semiconductors, RF modules, and other electronic components.

www.mouser.com/news/st-sensors-ebook-2019/mobile/index.html

GigaDevice NV memory now in stock at Mouser

As part of a distribution agreement and partnership with GigaDevice, a leading provider of non-volatile memory solutions, Mouser Electronics is now an authorized distributor of GigaDevice SPI NOR, SPI NAND, and parallel NAND flash memory devices that are ideal for embedded applications such as automotive, consumer electronics, IoT, industrial, mobile devices, computing, networking, and telecom.

Mouser is stocking a wide range of GigaDevice memory solutions.

The GD25 SPI NOR flash memory family is available in four voltage variants, and offers 20-year data retention and 100,000 program/erase cycles for high reliability.

The family includes the new high-speed quad NOR flash solution GD25LT series, as well as the high-speed octal GD25LX series — a high-performance NOR flash solution developed for applications that require fast read/write of massive code, such as automotive, artificial intelligence (AI), and IoT. Additionally, the family's GD25WDxxCK series includes the industry's smallest 1.5mm × 1.5mm USON8 molding type package — 60 percent smaller than existing 3mm × 2mm USON8 packages.

Both the GD5F SPI NAND flash family and GD9F parallel NAND flash family offer the high-capacity storage and performance necessary for multimedia data storage applications on mobile devices, set-top boxes, data cards, TVs and more.

Both product families are available in two voltage options, with densities up to 4Gbits (GD5F family) or 8Gbits (GD9F family). The low-pin-count GD5F family offers a high speed clock frequency of up to 120MHz plus quad I/O rates up to 532Mbits per second (Mbit/s). The GD9F devices feature I/O read performance as low as 25ns, as well as on-chip security features and multiple package options.

www.mouser.com/manufacturer/gigadevice

GigaDevice

Mouser adds CML Microcircuits

Mouser has signed a global distribution agreement with CML Microcircuits, a world leader in the design, development and supply of low-power analogue, digital and mixed-signal semiconductors for telecommunications systems.

CML Microcircuits' CMX901 and CMX902 devices are three-stage wideband, high-gain, and high-efficiency RF power amplifier ICs.

The devices offer high power gain up to 40 dB and approximately 60 percent power added efficiency, and are ideal for VHF and low UHF radio applications, such as data modules, marine VHF communications, RF transmitters, and radio applications used in Industrial Internet of Things systems.

Mouser is also now stocking four series of CML receiver ICs, including the CMX994 direct conversion receivers. The CMX994 receiver ICs include PowerTrade™, which provides the ability to dynamically select power consumption versus performance modes to optimize operating trade-offs.

The CMX994A and CMX994E models feature extended operation of 50MHz to 1218MHz, while the CMX994G offers guaranteed down-converter performance to 30MHz.

CML Microcircuits' wireless packet data modems address a wide range of communications and control applications, offering operation to custom, free format, and packet data systems. The CMX7164 is a multi-mode wireless data modem that supports multiple modulation schemes and coding systems, all configurable under host control with no external codecs or DSP processing required. Adaptive Coded Modulation (ACM) features allow modulation type and block format to be changed on the fly to dynamically select data block size, coding rate and CRC size.

The modem uses CML's FirmASIC® component technology, which provides maximum flexibility and a platform for custom modulation schemes.

The SCT2400 is a highly integrated digital radio transceiver based on spread spectrum modulation operating in the 2.4GHz ISM frequency range. The transceiver features a long range of over 12km (line of sight) with up to 100mW of output power, and can maintain clarity and security over long ranges in low-power radio systems. The device's low power consumption and security features make it ideal for portable, mobile, and wearable products such as fitness trackers, smart clothing, and wireless headsets.

www.mouser.com/manufacturer/cml-microcircuits

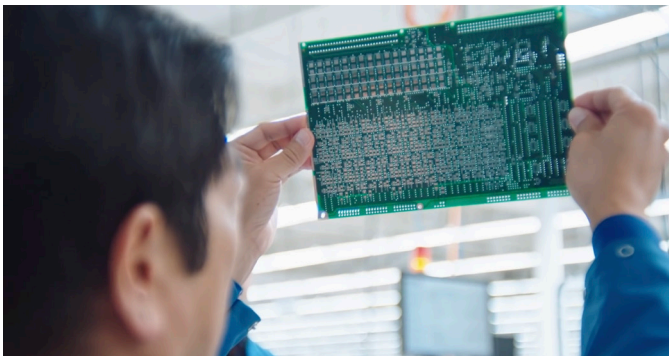
CML Microcircuits

Mouser and Grant Imahara showcase Contract Manufacturing

The final installment of the Engineering Big Ideas video series featuring celebrity engineer Grant Imahara takes viewers to Silicon Valley, where Imahara meets with Beth Kendrick, President of Valley Services Electronics (VSE) — a full-service manufacturer that assembles custom PCBs, specializing in low-volume and prototype electronics services.

"Manufacturing is often one of the last and most important stops on the electronic design engineer's journey to product creation," said Glenn Smith, President and CEO of Mouser Electronics, an authorized global distributor of the newest semiconductors and electronic components. "In order to push products through to the finish line, it is essential for product engineers to be on the lookout for any red flags when selecting components for their products and then when choosing the right manufacturing partner."

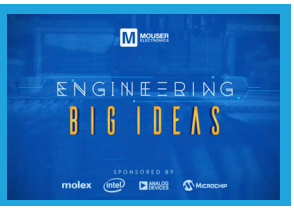
The new video goes behind the scenes with Kendrick and the VSE team, who share first-hand advice for new product innovators and highlight what creators should look for in a PCB assembly manufacturer to ensure a smooth go-to-market process.



The team describes how they broke through the confines of offshore manufacturing norms and what that means for today's innovators.

"Asking all of the key questions, the right how, why and what, to potential manufacturing partners is critical to ensuring your vision and product come to fruition. We are excited to showcase this last step," Imahara added.

To watch the enlightening video, go to **https://mou.sr/EIT2019-4**



Making Sense of Sounds, or How Analog Devices' AI Can Boost Your Machine Uptime

By Sebastien Christian, Cognitive Scientist, for Analog Devices Inc

Anyone familiar with the necessity of maintaining a mechanical machine knows how important the sounds and vibrations it makes are. Proper machine health monitoring through sound and vibrations can cut maintenance costs in half and double the lifetime. Implementing live acoustic data and analysis is another important approach for condition-based monitoring (CbM) systems.

We can learn what the normal sound of a machine is. When the sound changes, we identify it as abnormal. Then we may learn what the problem is so that we can associate that sound with a specific issue. Identifying anomalies takes a few minutes of training, but connecting sounds, vibrations, and their causes to perform diagnostics can take a lifetime. There are experienced technicians and engineers with this knowledge, but they are a scarce resource. Instinctively recognizing a problem from sound alone can be difficult, even with recordings, descriptive frameworks, or in-person training with experts.

Guiding Principles

To be robust, agnostic, and efficient, the OtoSense design philosophy followed some guiding principles:

- **Get inspiration from human's neurology.** Humans can learn and make sense of any sound they can hear in a very energy efficient manner.
- **Be able to learn stationary sounds as well as transient sounds.** This requires adapted features and continuous monitoring.
- **Perform the recognition at the edge, close to the sensor.** There should not be any need of a network connection to a remote server to make a decision.
- **Interaction with experts and the necessity to learn from them must happen with minimal impact on their daily workload,** and be as enjoyable as possible.

> "Humans can learn and make sense of any sound they can hear in a very energy efficient manner."

Because of this, our team at Analog Devices has spent the last 20 years on understanding how humans make sense of sounds and vibrations. Our objective was to build a system able to learn sounds and vibrations from a machine and decipher their meaning to detect abnormal behavior and to perform diagnostics. This article details the architecture of OtoSense, a machine health monitoring system that enables what we call computer hearing, which allows a computer to make sense of the leading indicators of a machine's behavior: sound and vibration.

This system applies to any machine and works in real time with no network connection needed. It has been adapted for industrial applications and it enables a scalable, efficient machine health monitoring system.

This article delves into the principles that guided OtoSense's development, and the role of human hearing in designing OtoSense.

The article then discusses the way sound or vibration features were designed, how meaning is derived from them, and the continuous learning process that makes OtoSense evolve and improve over time to perform increasingly complex diagnostics with increasing accuracy.

The Human Hearing System and Translation to OtoSense

Hearing is the sense of survival. It's the holistic sense of distant, unseen events, and it matures before birth.

The process by which we humans make sense of sounds can be described in four familiar steps: analog acquisition of the sound, digital conversion, feature extraction, and interpretation. In each step, we will compare the human ear with the OtoSense system.

- **Analog acquisition and digitization.** A membrane and levers in the middle ear capture sounds and adjust impedance to transmit vibrations to a liquid-filled canal where another membrane is selectively displaced depending on spectral components present in the signal. This in turn bends flexible cells that emit a digital output that reflects the amount and harshness of the bending. These individual signals then travel on parallel nerves arranged by frequency to the primary auditory cortex.
  - In OtoSense, this job is performed by sensors, amplifiers, and codecs. The digitization process uses a fixed sample rate adjustable between 250 Hz and 196 kHz, with the waveform being coded on 16 bits and stored on buffers that range from 128 samples to 4096 samples.

- **Feature extraction** happens in this primary cortex: Frequency-domain features such as dominant frequencies, harmonicity, and spectral shape, as well as time-domain features such as impulsions, variations of intensity, and main frequency components over a time window spanned around 3 seconds.

  - OtoSense uses a time window that we call chunk, which moves with a fixed step size. The size and step of this chunk can range from 23 ms to 3 s, depending on the events that need to be recognized and the sample rate, with features being extracted at the edge. We'll provide more information on the features extracted by OtoSense in the next section.

- **Interpretation happens in the associative cortex**, which merges all perceptions and memories and attaches meaning to sounds, such as with language, which plays a central role in shaping our perceptions. The interpretation process organizes our description of events far beyond the simple capacity of naming them. Having a name for an item, a sound, or an occurrence allows us to grant it greater, more multilayered meaning. For experts, names and meaning allow them to better make sense of their environment.

  - This is why OtoSense interaction with people starts from visual, unsupervised sound mapping based on human neurology. OtoSense shows a graphical representation of all the sounds or vibration heard, organized by similarity, but without trying to create rigid categories. This lets experts organize and name the groupings seen on screen without trying to artificially create bounded categories. They can build a semantic map aligned with their knowledge, perceptions, and expectations regarding the final output of OtoSense. The same soundscape would be divided, organized, and labelled differently by auto mechanics, aerospace engineers, or cold forging press specialists—or even by people in the same field but at different companies. OtoSense uses the same bottom-up approach to meaning creation that shapes our use of language.

From Sound and Vibration to Features

A feature is assigned an individual number to describe a given attribute/quality of a sound or vibration over a period of time (the time window, or chunk, as we mentioned earlier). The OtoSense platform's principles for choosing a feature are as follows:

- **Features should describe the environment** as completely as possible and with as many details as possible, both in the frequency domain and time domain. They have to describe stationary hums as well as clicks, rattles, squeaks, and any kind of transient instability.

- **Features should constitute a set as orthogonally as possible.** If one feature is defined as "the average amplitude on the chunk," there should not be another feature strongly correlated with it, as a feature such as "total spectral energy on the chunk" would be. Of course, orthogonality is never reached, but no feature should be expressed as a combination of the others—some singular information must be contained in each feature.

- **Features should minimize computation.** Our brain just knows addition, comparison, and resetting to 0. Most OtoSense features have been designed to be incremental so that each new sample modifies the feature with a simple operation, with no need for recomputing it on a full buffer or, worse, chunk. Minimizing computation also implies not caring about standard physical units. For example, there is no point in trying to represent intensities with a value in dBA. If there is a need to output a dBA value, it can be done at the time of output if necessary.

A portion of the OtoSense platform's two to 1024 features describe the time domain. They are extracted either right from the waveform or from the evolution of any other feature over the chunk.

Some of these features include the average and maximal amplitude, complexity derived from the linear length of the waveform, amplitude variation, the existence and characterization of impulsions, stability as the resemblance between the first and last buffer, skinny autocorrelation avoiding convolution, or variations of the main spectral peaks.

The features used on the frequency domain are extracted from an FFT. The FFT is computed on each buffer and yields 128 to 2048 individual frequency contributions. The process then creates a vector with the desired number of dimensions—much smaller than the FFT size, of course, but that still extensively describe the environment.

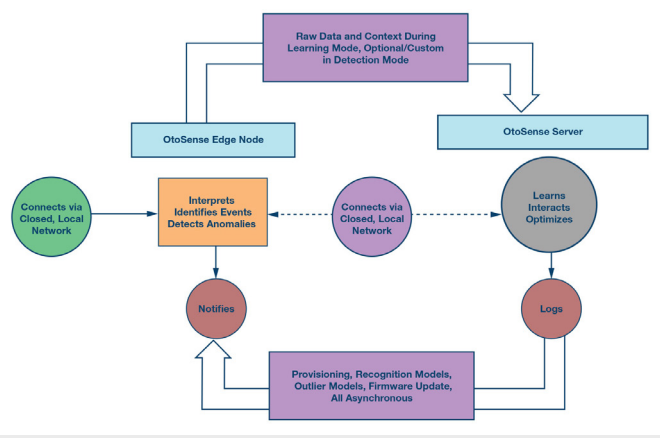


Figure 1. The OtoSense system. (Source: Analog Devices)

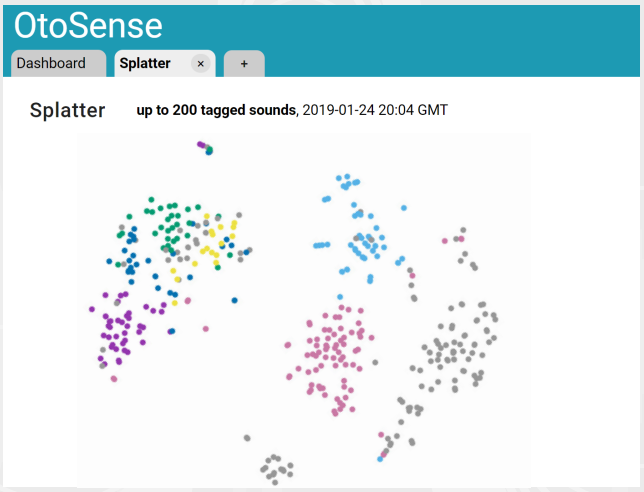


Figure 2. A 2D splatter map of sound in the OtoSense Sound Platter. (Source: Analog Devices)

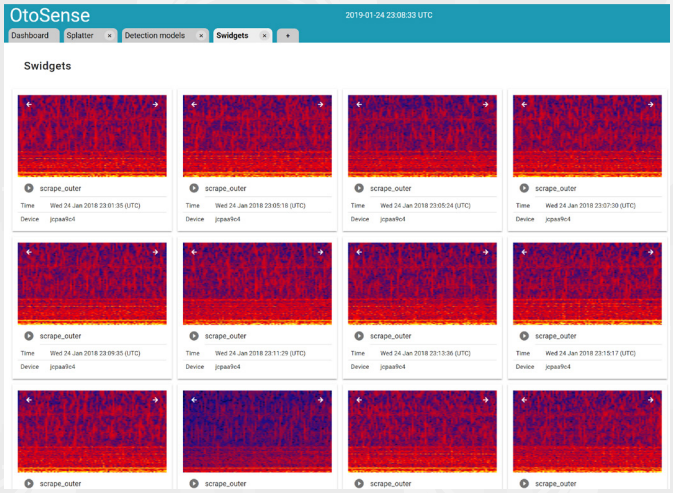


Figure 3. OtoSense sound widgets (swidgets). (Source: Analog Devices)

OtoSense initially starts with an agnostic method for creating equal-sized buckets on the log spectrum.

Then, depending on the environment and the events to be identified, these buckets adapt to focus on areas of the spectrum where information density is high, either from an unsupervised perspective that maximizes entropy or from a semi-supervised perspective that uses labelled events as a guide. This mimics the architecture of our inner ear cells, which is denser where the speech information is maximal.

Architecture: Power to the Edge and Data on Premises

Outlier detection and event recognition with OtoSense happen at the edge, without the participation of any remote asset. This architecture ensures that the system won't be impacted by a network failure and it avoids having to send all raw data chunks out for analysis. An edge device running OtoSense is a self-contained system describing the behavior of the machine it's listening to in real time.

The OtoSense server, running the AI and HMI, is typically hosted on premises. A cloud architecture makes sense for aggregating multiple meaningful data streams as the output of OtoSense devices. It makes less sense to use cloud hosting for an AI dedicated to processing large amounts of data and interacting with hundreds of devices on a single site.

From Features to Anomaly Detection

Normality/abnormality evaluation does not require much interaction with experts to be started. Experts only need to help establish a baseline for a machine's normal sounds and vibrations. This baseline is then translated into an outlier model on the Otosense server before being pushed to the device.

We then use two different strategies to evaluate the normality of an incoming sound or vibration:

- The first strategy is what we call usualness, where any new incoming sound that lands in the feature space is checked for its surrounding, how far it is from baseline points and clusters, and how big those clusters are. The bigger the distance and the smaller the clusters, the more unusual the new sound is and the higher its outlier score is.

When this outlier score is above a threshold as defined by experts, the corresponding chunk is labelled unusual and sent to the server to become available for experts.

- The second strategy is very simple: any incoming chunk with a feature value above or below the maximum or minimum of all the features defining the baseline is labelled as extreme and sent to the server as well.

The combination of unusual and extreme strategies offers good coverage of abnormal sounds or vibrations, and these strategies perform well for detecting progressive wear and unexpected, brutal events.

From Features to Event Recognition

Features belong to the physical realm, while meaning belongs to human cognition. To associate features with meaning, interaction between OtoSense AI and human experts is needed. A lot of time has been spent following our customers' feedback to develop a human-machine interface (HMI) that enable engineers to efficiently interact with OtoSense to design event recognition models. This HMI allows for exploring data, labelling it, creating outlier models and sound recognition models, and testing those models.

The OtoSense Sound Platter (also known as splatter) allows for the exploration and tagging of sounds with a complete overview of the data set. Splatter makes a selection of the most interesting and representative sounds in a complete data set and displays them as a 2D similarity map that mixes labelled and unlabelled sounds.

Any sound or vibration can be visualized, along with its context, in many different ways—for example, using Sound Widgets (also known as Swidgets).

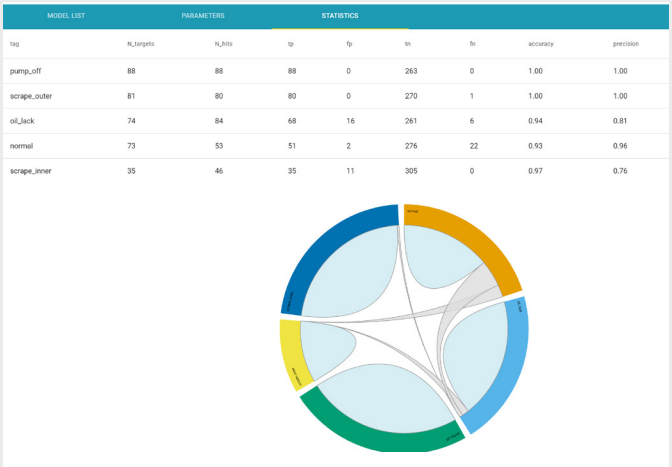


Figure 4. An event recognition model can be created based on the required events. (Source: Analog Devices)

At any moment, an outlier model or an event recognition model can be created. Event recognition models are presented as a round confusion matrix that allows OtoSense users to explore confusion events.

Outliers can be explored and labelled through an interface that shows all the unusual and extreme sounds over time.

The Continuous Learning Process, from Anomaly Detection to Increasingly Complex Diagnostics

OtoSense has been designed to learn from multiple experts and allow for more and more complex diagnostics over time. The usual process is a recurring loop between OtoSense and experts:

- An outlier model and an event recognition model are running at the edge. These create output for the probability of potential events happening, along with their outlier scores.
- An unusual sound or vibration above the defined threshold triggers an outlier notification. Technicians and engineers using OtoSense can then check on the sound and its context.
- These experts then label this unusual event.
- A new recognition model and outlier model that includes this new information is computed and pushed to edge devices.

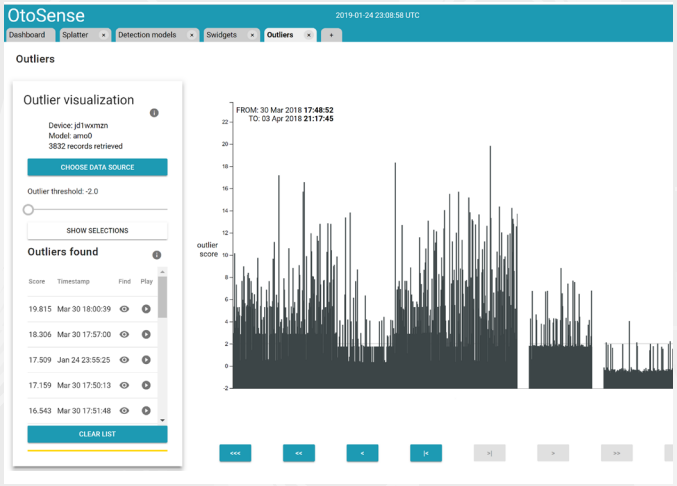


Figure 5. Sound analytics over time in the OtoSense Outlier visualization. (Source: Analog Devices)

Conclusion

The objective of the OtoSense technology from Analog Devices is to make sound and vibration expertise available continuously, on any machine, with no need for a network connection to perform outlier detection and event recognition. This techonology's growing use for machine health monitoring in aerospace, automotive, and industrial monitoring applications has shown good performance in situations that once require human expertise and in situations involving embedded applications, especially on complex machines.

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Dear Mouser...

In this section, a Mouser employee answers your questions.

This month, **Marie-Pierre Ducharme, Director Supplier Marketing & Business Development EMEA** is in the hotseat.

Q1) **EIU:** Mouser is expanding its warehouse in Mansfield. I assume this means more space, but also more automation?

MPD: Yes, this is correct. Mouser is expanding again and the construction & infrastructure of the new space should be completed by the end of the first quarter. As the breadth of inventory is vital to Mouser, we want to make sure we can stock all new products from our 800+ authorised manufacturers. Using automation, we are also becoming more efficient. We have installed 55 Vertical Lift Modules and are also adding an Auto-Store in the warehouse. As the number of buyers & items we ship increases, the efficiency in our warehouse is key in order to keep our standards as high as they've always been and make sure we offer best in class service to our customers.

Q2) **EIU:** Mouser creates a lot of technical content, where is the best place to look and search for it?

MPD: We have announced a new Technical Resources Center on Mouser.com, which is accessible from the homepage. As you know, Mouser invests time and resources in creating unique content around products, technologies & applications, which is helping customers with their projects. All of the E-Books, articles, blogs, EIU editions and much more are consolidated under this Resources Center. It also allows customers to search by type of content or by topic, which is very convenient. (https://eu.mouser.com/technical-resources/)

Q3) **EIU:** What key technologies and trends is Mouser seeing in 2020?

MPD: Mouser sees a lot of interest and design-in activity around AI. We're seeing it deployed in almost all sectors. In telecommunications, 5G developments will continue enabling many new applications. When looking at the automotive market, the development of electric vehicles will continue pushing for more efficient manufacturing through the deployment of Industry 4.0 technology systems.

Please send your questions to Nick.Foot@bwwcomms.com

The Edge of Embedded

By Marcel Consée
For Mouser Electronics

One of the favorite trick questions in tech job interviews during the final decade of the last millennium was to explain the difference between SAN and NAS. The HR officers of that time did not listen to the explanation given since they generally didn't know what either was. The decisive factor was solely the amount of spluttering on the applicants' side.

Talking about the computing concepts of "Cloud" and "Edge" today reminds me of these times. It's so easy to get muddled, and when you add "AI," there's no help. Funnily enough, there's no clear "official" definition by one of the standardisation bodies. For our purposes, Edge computing is a form of distributed computing that brings computation and data storage close to the location where it's needed in order to improve response time (Figure 1). Its origins lie in early content delivery networks, but the rise of sensor networks, distributed embedded systems and IoT technologies in industrial applications and beyond have driven the development significantly. All those applications areas produce too much data for it to be transferred to data centers, and low latency becomes essential when the local system is supposed to react to the sensor input.

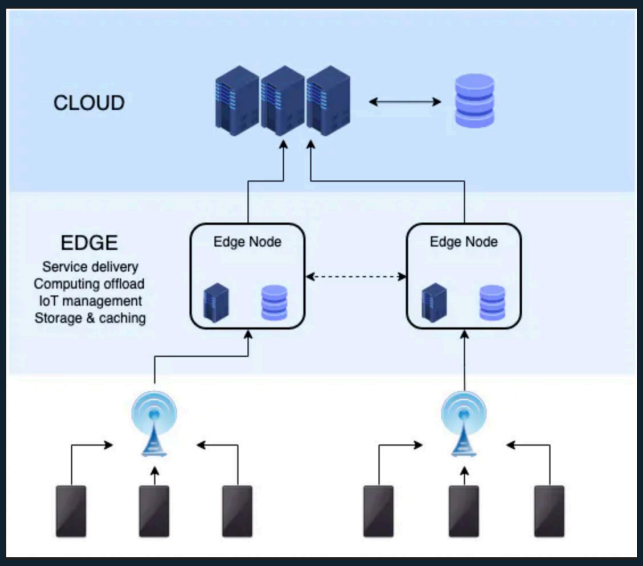


Figure 1: Edge computing can be seen as an intermediate layer between devices and cloud, where distributed edge nodes handle services. (Source: NoMore201 [CC BY-SA 4.0 (https://creativecommons.org/licenses/by-sa/4.0)]

That's crucial in industrial systems and becomes more pressing with the advent of more or less self-driving vehicles that produce enormous amounts of data and have to react in milliseconds.

Offloading Computing Power

The purpose of Edge application services is to reduce the volumes of data that must be moved. That leads to lower latency, lower transmission costs. Computation offloading for real-time applications, e.g. facial recognition algorithms, shows considerable improvements in response times.

This means, however, that the local computing power needs to be sufficiently high for these kinds of applications. Think of resource-rich machines called "cloudlets" that offer services typically found in the cloud and are much closer to a small data center than to a typical embedded system. Examples for this can be found in mobile gaming and in voice assistants like Siri, but offloading every task may result in a slowdown due to transfer times between device and nodes. Thus, it makes sense to define an optimal configuration based on the workload.

Introducting Intelligence

From a workload perspective, the amount of data acquired by local sensors can be classified as either time-critical—i.e. it requires a response—or non-critical. In the second case, it can be stored away to the cloud for subsequent analysis. In order to do this efficiently, data compression might be in order. The other kind of data has to be analysed and managed immediately, right at the application edge. Both approaches allow number-crunching FPGA-based devices to play their strength.

Figure 2: Xilinx Alveo Accelerator card (Source: Mouser Electronics)

"This active configuration includes a heat sink and fan enclosure cover to provide appropriate cooling."

The two major FPGA manufacturers, Xilinx and Altera/Intel, combine their FPGA fabric with artificial intelligence engines and high-speed connectivity.

A solution that can act on the Edge as well as in full-fledged data centers is Xilinx Alveo (Figure 2). These PCI Express (PCIe) Gen3x16 compliant cards are designed to accelerate compute-intensive applications such as database acceleration, machine learning, data analytics, and video processing. The cards are available in both active and passive cooling configurations. The passive cooling card is designed to be installed into a data center server, where controlled airflow provides direct cooling. The active cooling card is intended to be installed into a PC environment where the airflow is uncontrolled. This active configuration includes a heat sink and fan enclosure cover to provide appropriate cooling.

Intel takes a similar approach with the Programmable Acceleration Card with Arria® 10 GX, focusing on computing power.

Figure 3: Stratix Series FPGA Development Tools (Source: Mouser Electronics)

Together with embedded solutions based on Zynq architecture, e.g. industrial control with the Zynq-7000 and AI Inference engines like Xilinx VITIS allows for continuous data flow between Sensor, Edge, and Cloud. The Evaluation Kit gives a good overview.

Since it's been acquired by Intel, Altera takes a more processor-centric approach. With Intel's expertise in this area and the research conducted on artificial intelligence, the Intel/Altera Edge solutions tackle the challenge from a different angle. The Stratix V FPGAs deliver the necessary connectivity, and specialized development kits, e.g. the Intel DSP Development Kit, Stratix V Edition, simplify design in specific areas. (Figure 3).

Intel realized a portable approach to artificial intelligence with its Neural Compute Sticks. Neural Compute Stick 2 is powered by the Intel Movidius X VPU. It supports OpenVINO, a toolkit that accelerates solution development and streamlines deployment. The Neural Compute Stick 2 offers plug-and-play simplicicty, support for common frameworks and out-of-the-box sample applications. It delivers 4 trillion operations per second.

Conclusion

The combination of AI technology with programmable logic, connectivity and computing power offers convincing solutions for Edge applications. The current developments open up application areas that traditionally made use of data centers.

Technology that Speaks the Same Language

By Paul Golata, For Mouser Electronics

Introduction

Goo Goo Gaga is a simple interjection. It is onomatopoeia from the Greek "onoma" for "name" and "poiein" for "to make," meaning "to make a name". It is a phrase that resembles the sounds that a baby makes before they are old enough and smart enough to carry on a conversation (Figure 1). Somehow, as if by osmosis, babies naturally learn to speak and ultimately converse in the native language they find themselves living in.

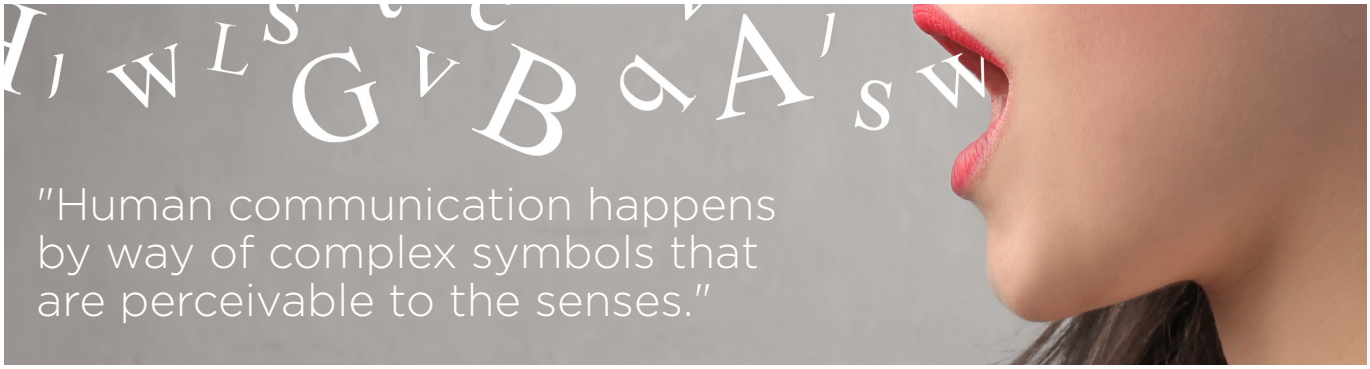
If only it were like this for computers and machines. Instead, these items need to be programmed by humans. Natural language processing (NLP), a subset within the domain of artificial intelligence (AI), combines high technology with the linguistics of human language, enabling machines and humans to communicate. It provides machines with the ability to understand both written and spoken human communication. It allows humans and machines to speak the same language and to talk to each other to exchange information and ideas. This article will look at how AI is helping us to have conversations with our machines.

Human Language

The field of linguistics studies the methods and manner whereby processed information is communicated both internally and externally to things with intelligence. Humans use what is called natural language. Natural language can be coupled with technology. Conversational AI is helping to merge humans' sophisticated communication and intellectual abilities with their technological capabilities.

Human communication happens by way of complex symbols that are perceivable to the senses. Notable human examples include speech (hearing), written or sign language (visual), and physical contacts such as handshakes and hugs (touch). Raymond Kurzweil, who was hired by Google in 2012 with the mission of bringing natural language insight and understanding to the company, asserts that human language was the first invention of humanity. Language is a way that humans can work together and build a society, have culture, and create technology.

All intelligence-manipulating communication requires a method to structure language. Grammar, syntax, and discourse provide structure to a language so that its constituent components may be appropriately understood and interpreted. Author, critic, and educator Neil Postman (1931–2003) believes that language is "pure ideology" and should be viewed as an "invisible technology." By this, Postman means that language is not neutral. It is a reflection of the starting assumptions and its use frames the entire informational content that intelligence utilizes.



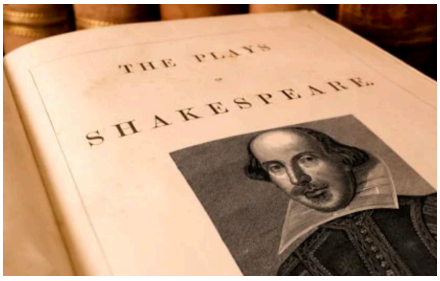


Figure 2: The title page from an antique book of the plays of Shakespeare. (Source: Mouser Electronics)

Interpretation is the art of adequately receiving communication and processing it in the manner that was intended by the communicator.

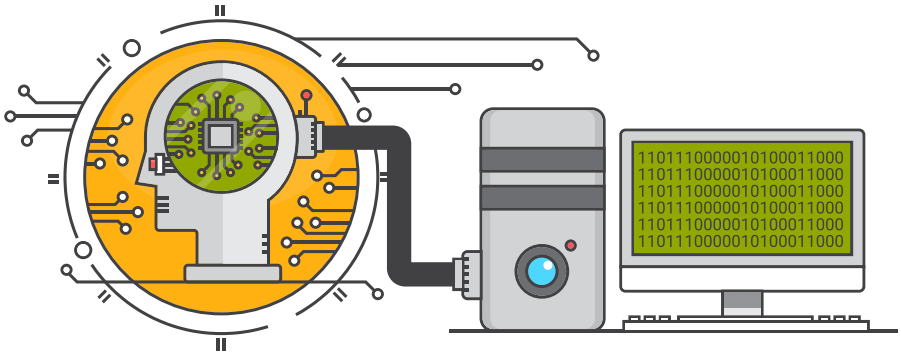
The circumstances surrounding the specific grammar, syntax, and discourse employed are called the context. It provides the external and internal environment into which the information is being processed.

The context that language finds itself in is a critical key in ascertaining what a communication means from the perspective of the communicator's intention. Because the intention of the communicator matters to the context, the issue of agency is brought to bear. If intention is not part of the communicated message, then whatever is transmitted cannot produce meaningful action since it will have only been derived from an original set of happenstance, from which it is not possible to assert meaning.

Humans can create and utilize symbols to express themselves in new and unique ways without limitation. A human can cry in pain, read Shakespeare, or sing an opera (Figure 2). These symbols come to have meaning as a result of social interaction and agreement. Because human language is based upon social purpose, it allows both change over time and unlimited variety as society develops new symbols to communicate what people experience.

Other life forms can communicate in a manner that is natural yet distinct and different from human language. This communication is generally a form of signaling understood within the species, but it does not involve the manipulation of symbols and creative thought.

"Humans have created these machines and programming languages to be able to participate in what the machine is capable of doing."



For example, a dog's bark may provide information to other dogs who receive it and understand in a manner beyond general human understanding.

Animals may also use other ways to communicate that are not inherently understandable to humanity at initial glances, such as the abilities of bees to do a dance that indicates the direction to fly to obtain pollen for the hive.

Scientists recognize that, even though animals may communicate with other animals of their species, there is no animal, including apes and chimpanzees, that can manipulate signs and symbols to the degree that humanity can. Animals only work and communicate regarding particular contexts and do not communicate regarding universal or abstract relationships.

From Humans to Machines

In contrast, machines and computers do not use human language. Their intelligence happens in the form of AI. All AI utilizes programming, which enables it to receive information, compute, and act in an attempt to make sense of what it is experiencing. Humans have created these machines and programming languages to be able to participate in what the machine is capable of doing.

These languages follow a specific set of rules that have been agreed upon by social and primarily scientific convention. Because of the general desire to be utilized universally, they are most frequently constructed with formality; that is, there is a universally agreed-upon method to the logic contained within the artificial language. Artificial languages (machine code or code) can be set up to perform specific predefined tasks.

Programming is the art and science of writing machine code. It is performed by manipulating the functionally equivalent elements found in human language, including grammar, syntax, semantics, and discourse.

Programming is initially set up by humans but can be assigned to be done by machines (robots/computers) after the initial setup. An algorithm is a set of instructions that have been formatted and arranged to achieve a specific function.

Programming code is generally broken down into a long series of discrete binary digital signals. These signals, representing particular ON and OFF sequences, are then stored, analyzed, and processed in conjunction with the available intelligence of the machine.

All AI programming is based upon human conceptions of structure. AI semantics and syntax thus function in a manner that emulates humans rather than, for instance, another species like apes, dolphins, or rats.

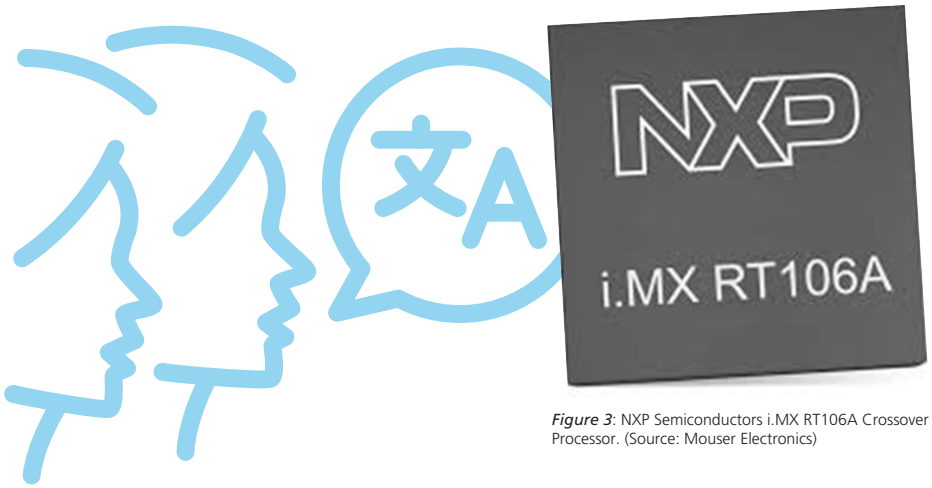


Figure 3: NXP Semiconductors i.MX RT106A Crossover Processor. (Source: Mouser Electronics)

Figure 4: Intel® Xeon® Second Generation Scalable Gold Processors optimized for inferencing. (Source: Mouser Electronics)

"Machines must be able to train themselves quickly from a vast field of language in order to understand humans."

Large Model Sizes

Human language is vast and complicated. It is a collection of shared knowledge and wisdom. Understanding and meaning are derived from experience and context. The tremendous amount of variables means that the model size for one language, such as English, is vast. When expanded to understand other languages that operate in different ways such as Chinese, French, German, Hindi, Japanese, Spanish, etc. the model sizes required are genuinely staggering.

Language models must train on the most extensive and broadest data sets available to capture the most exceptional level of nuance implied in the message. The upshot is that AI and NLP models must be able to handle a vast amount of data and access it quickly and efficiently to have everything needed for understanding.

High Computation Demands

Machines must be able to train themselves quickly from a vast field of language in order to understand humans.

This requires high computational capabilities. GPUs, FPGAs, CPUs, ASICs, crossover processors, and microcontroller units (MCUs) are necessary elements for any successful implementation.

Let's look further at how a crossover processor might be part of a conversational AI solution.

Applications processors and MCUs are employed in embedded applications. Applications processors provide excellent integration and performance, while MCUs are easy-to-use and low cost. NXP Semiconductors has placed these two products together to provide one part that can simultaneously provide high performance, low latency, power efficiency, and security in a low cost part. This product is ideally suited to handle a variety of human language and voice-assistance applications.

NXP Semiconductors i.MX RT106A Crossover Processor is a solution specific variant of the i.MX RT1060 family of MCUs, targeting cloud-based embedded voice applications (Figure 3). It features NXP's advanced implementation of the Arm® Cortex®-M7 core, which operates at speeds up to 600MHz to provide high CPU performance and the best real-time response. i.MX RT106A based solutions enable system designers to easily add voice control capabilities to a wide variety of smart appliances, smart home, smart retail, and smart industry devices.

The i.MX RT106A is licensed to run NXP turnkey voice-assistant software solutions, which may include a far-field audio front-end softDSP, wake-word inference engine, media player/streamer, and a host of associated items.

Instant Inferencing

Machines must also be able to train themselves quickly from the massive field of human language and be able to draw exceptionally fast inferencing with extremely low latency times if not in real-time. Products like Intel® Xeon® Second Generation Scalable Gold Processors are enhanced to produce excellent inferencing results (Figure 4).

These Intel processors are 64-bit, multicore server microprocessors built on 14nm lithography process technology. The processors are based on the Cascade Lake microarchitecture that allows for higher clock speeds. The processors are also optimized for demanding mainstream data centers, multi-cloud computing, and network and storage workloads. These processors offer up to 22 cores/44 threads and feature Intel Turbo Boost Technology 2.0 that ramps up to 4.4GHz. The processors also feature up to four-socket scalability and support up to 46-bits of physical address space and 48-bits of virtual address space. The devices take embedded AI performance to the next level with new AI acceleration, including new Intel® Deep Learning Boost.

Conclusion

Technology is talking sense. The implementation of AI and NLP is an example of an emerging technology that will allow humans and machines to communicate seamlessly and in real-time. Humans and machines are now starting to speak the same language.

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Optimizing control and design for industrial robotics

By Lalindra Jayatilleke, Kazunobu Shin, Jason Reeder and Sunil Oak, Texas Instruments

Introduction

With the rise of factory automation, robotics has become increasingly important in the production of goods.

Robotics can increase manufacturing efficiency, reduce cost and increase quality. Globally, manufacturers are relying increasingly on robotics to churn out products with increased speed and consistency.

This white paper serves as an introduction to industrial robots in general and more specifically about robot control units.

It covers some important applications and system technologies that would help understand how industrial robots control units are architected, as illustrated in Figure 1.

For more information on this topic, read our how sensor data is powering artificial intelligence (AI) in robotics white paper.

Applications

Applications that benefit from industrial robots are product assembly, material handling, machine tool management, packaging, welding and logistics.

Logistics robots especially have become increasingly important in online retail.

"Online retailers are starting to utilize autonomous logistics robots for order fulfillment."

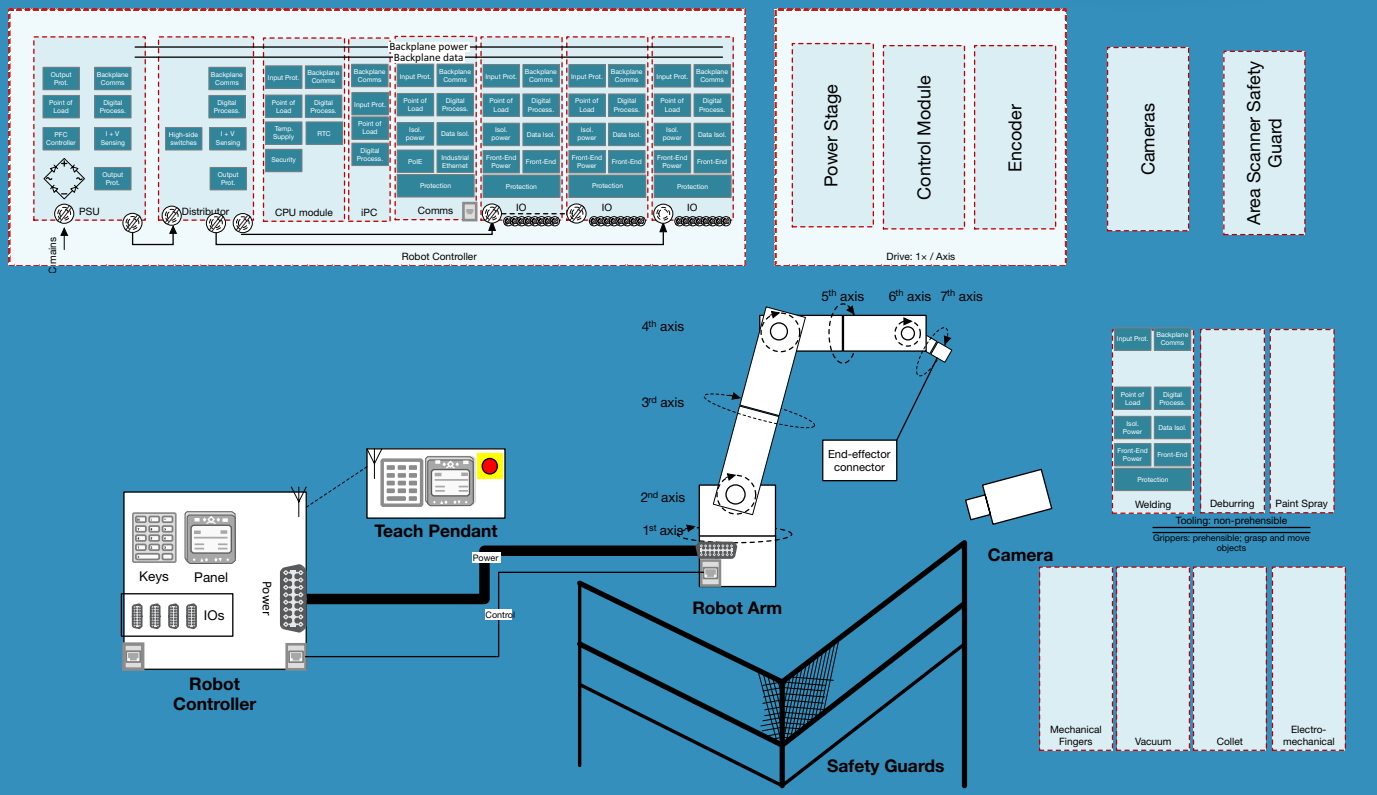


Figure 1: Typical system components in an industrial robot system. (Source: Texas Instruments)

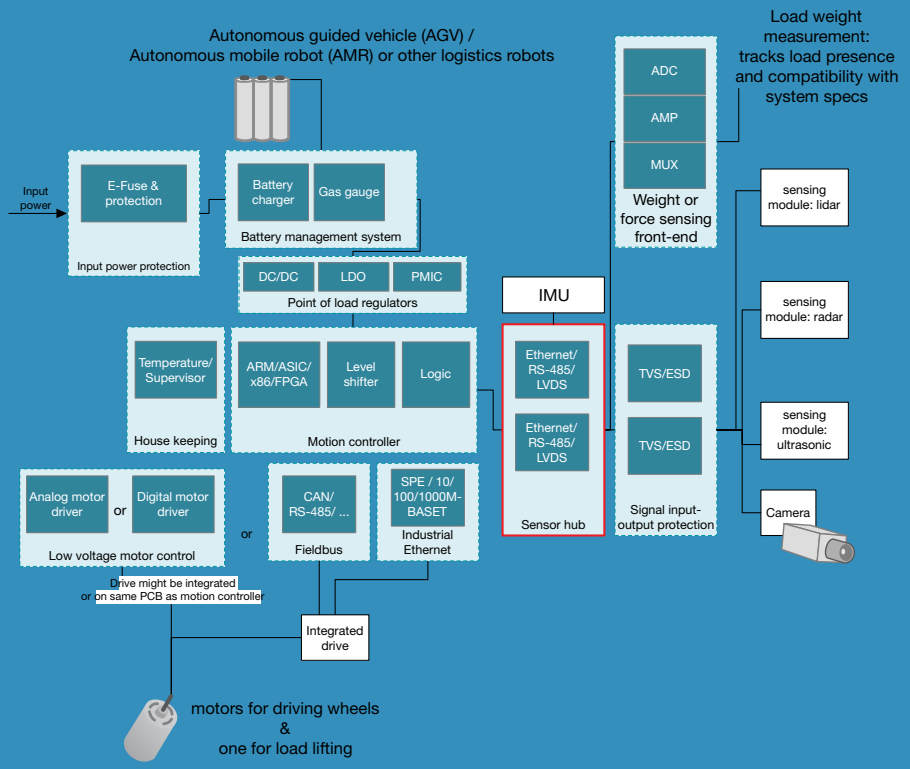


Figure 2: High level block diagram for an autonomous guided vehicle or robot. (Source: Texas Instruments)

These are autonomous robots that assist in gathering items for shipment from warehouse inventory, and efficiently enable shipment.

Figure 2 shows an example reference diagram for an autonomous guided vehicle (AGV). Online retailers are starting to utilize autonomous logistics robots for order fulfillment.

For large retailers, it would be nearly impossible to run their business without robotics or some form of automation. Some example applications for robotics are shown in Figure 3 below.

The advantages robotics provide are achieved by advances in functional safety and reliability of systems designed by robot vendors.

Texas Instruments (TI) has a wide range of processors that fit perfectly for these applications, including Sitara™ processors for the robot central processing unit (CPU) and Hercules™ Arm® Cortex®-R4 and -R5 based microcontrollers for functional safety applications.

"Drones are also used in some countries for vaccine and donor blood delivery services to rural regions."

Customers looking to achieve safety integrity levels (SIL) in their robot products can do so by designing their systems leveraging Hercules devices, followed by system certification from an independent assessor.

Another growing application for robotics is unmanned aerial vehicles (UAV) also known as drones. With advancements in sensor and battery technologies, drones have become common place in agriculture applications such as crop monitoring and soil and field analysis.

Drones are also used in some countries for vaccine and donor blood delivery services to rural regions. As technology evolves, more applications in robotics will emerge.

Industrial robot controller systems

High-end industrial robot controller

High-performance industrial robot systems in factories utilize robot arms, controllers and teach pendants. Various types of robot arms are available depending on the application. Each robot arm has their own number of controlled axes and payload capacity. The controller within the system is designed to manage many types of robot arms through a configurable and flexible system based on modular system architecture. See Figure 4 for a typical system block diagram for a high-end industrial robot. As far as scalability, the controller system supports functional modules and the capability to scale the performance and functionality based on the system configuration.

Logistic robots

Delivery robots

Forklifts

Palette jacks

Figure 3: Examples of robot applications. (Source: Texas Instruments)

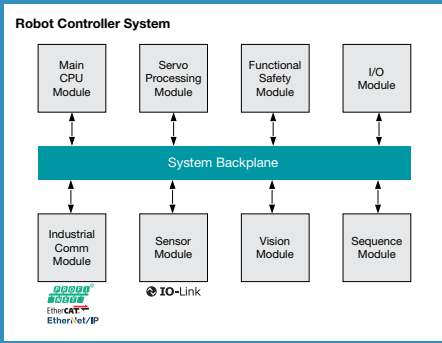


Figure 4: Robot controller system example for high-end industrial robots. (Source: Texas Instruments)

The basic robot controller system includes individual modules supporting the main CPU, motion control, input / output (I/O) control, sensor(s), functional safety and industrial communication. The backplane system bus to connect multiple functional modules is critical for high-performance robot operation and therefore requires high data throughput and low latency.

The typical robot controller system uses an application-specific integrated circuit (ASIC), PCIe or Ethernet base for the backplane system bus. In addition to these common modules of the robot controller system, an additional functional module can be added to extend the capability of the robot arm based on the requirements from various applications.

Sitara processors can cover the functionality and performance needs required by most functional modules in the high-end robot controller system category. Sitara AM57x processors can provide high processing performance required by the main CPU module and servo processing module. Digital signal processors (DSPs) provide additional signal processing performance required for servo and motion signal processing in lower power consumption.

Sitara AMIC processors are optimized for industrial communication and can be used as the interface to the system backplane bus when an industrial communication protocol is needed. Sitara processors can support multiple industrial communication protocols with programmable real-time unit industrial communications subsystem (PRU-ICSS). They can also reduce development cost and time required for developing separate modules for supporting various industrial communication protocols.

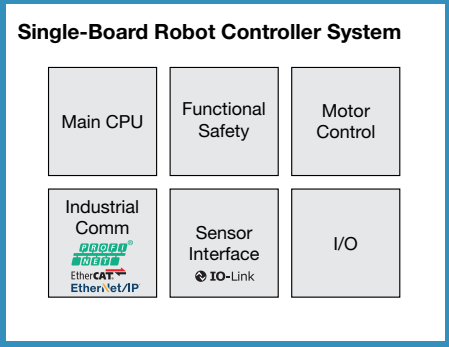


Figure 5: Single-board robot controller system for collaborative or SCARA robots. (Source: Texas Instruments)

Integrated robot controller for cobot and SCARA robot

The control system for a collaborative, or selective compliance assembly robot arm (SCARA), robot is simpler than a high-end robot controller, as it typically controls less axes and has a slower speed than high-end robots. Figure 5 shows an example system block diagram for a single-board robot controller system for collaborative or SCARA robots. The control system can also be much simpler and can consist of a single board or a few boards.

At the same time, smaller size and lower system cost becomes more important to save factory space and integrate the controller as a part of an industrial robot arm system. Because a SCARA robot can be placed much closer to humans, functional safety becomes more important to use a robot without other safety system such as safety fences.

Sitara AM57x and AM65x processors can support most of the required features and functionalities with integrated industrial communication, motor control and functional safety and realize robot controller system with fewer system components.

Controller for Cartesian robots

The robot controller solution for Cartesian, or single-axis, robot is much simpler and only requires basic functionality for controlling one or two axes motors. However, current controller systems are based on a few MCU and ASIC devices given that robot control and motor control are separated and additional industrial communication IC is required. Sitara AM437x and AMIC120 devices feature multi-protocol industrial communication, robot/ motion control and motor control including encoder interface with a single device and can support Cartesian robot controllers with one or two axes as shown in Figure 6.

Industrial communication

There are over a dozen different communication protocols on the market for industrial Ethernet, field-bus and position encoders, each with its own pros and cons. EtherCAT®, PROFINET® and EtherNet/Industrial Protocol are some of the most popular Ethernet-based protocols in the servo drives market. Hiperface® Digital Servo Link, EnDat 2.2 and Bidirectional Interface for Serial/Synchronous C are among the more popular position-encoder protocols for other types of industrial robots.

Many of these protocols have ASICs that allow users to attach to host processors to support specific communication protocols. In some cases, with a multi-chip solution, the protocol's stack runs on the host processor and the ASIC performs the media access control layer.

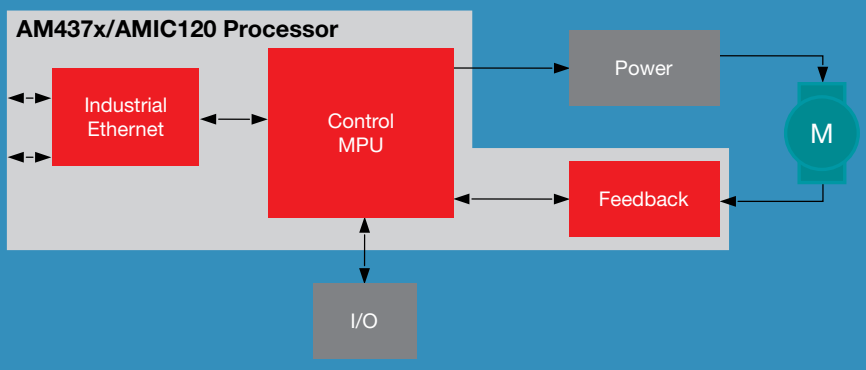
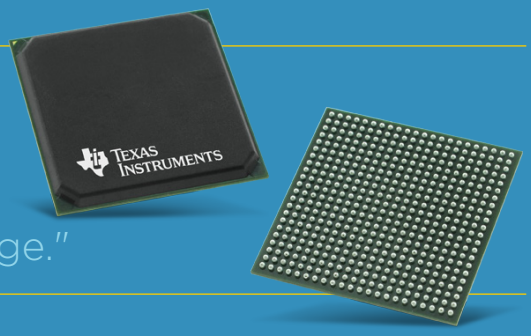


Figure 6: Single-chip robot controller system based on AM437x or AMIC120 processors. (Source: Texas Instruments)

"Sitara AM5749 processors enable designers to run machine learning inference at the edge."



Manufacturers who only plan to support a single protocol prefer this distributed architecture, since ASICs are typically optimized for specific communication standards. Once the need to support multiple protocols arises, a multi-chip solution loses its attractiveness because of the new development effort and costs and the maintenance of multiple versions of their boards for each protocol.

By leveraging integrated multiprotocol support onto the host processor, designers can save costs, board space and development effort, while also minimizing the latency associated with communication between external components and the host.

A single platform supporting multiple standards enables you to maintain a single board for the different versions of your end product. Another consideration is the need to support Time Sensitive Networking (TSN) and then desigining a solution that's flexible enough to adapt to evolving TSN standards. The Sitara AM6x processor family provides a solution through its flexible PRU-ICSS, which enables gigabit TSN as well as traditional 100-Mb protocols like EtherCAT.

Functional safety considerations

Industrial robots have been used for over five decades in widely varying applications, ranging from spot welding in manufacturing to the pick- and-place operations in the packaging industry. The emergence of more complex robotic applications and systems in recent years has led to advances in functional safety capability of MCUs.

This enables use of robots in new application environments and enables robotic automation that can operate in closer quarters with humans in the production environment.

While the use of collaborative robots in industrial production is only now beginning, there has been a lot of work already in the development of the required safety capabilities residing in sensors and processors and in the standardization of industrial robot requirements.

Highly integrated MCUs and processors can also help streamline functional safety development. Developed according to the IEC-61508 safety standards, TI Hercules MCUs include features enabling functional safety in hardware and detect potential failure modes with quick response time. Hercules MCUs are also used in applications requiring a dedicated processor to perform a specialized function.

In these systems, the Hercules MCUs function as the "safety checker" that ensures that the system is always maintained in a safe state of operation. Sitara AM65x Arm-based processors feature two or four Arm Cortex-A53 cores and include a dual-Arm Cortex-R5F MCU subsystem to make it easier for customers to develop functional safety applications. To learn more about functional safety, read our white paper titled, "The state of functional safety in Industry 4.0."

Enabling machine learning

As robotic technologies advance, so do complementary sensor technologies. Much like the five senses of a human being, combining different sensing technologies offers the best results when deploying robotic systems into changing and uncontrolled environments.

Even the simplest tasks that a robot performs will depend on machine vision to feed data into machine learning technology.

Grasping an object, for example, without pre-determined locations and motions would be impossible without leveraging machine vision to reconstruct a 3D image and utilizing machine learning algorithms to translate this visual information into a successful action on the part of the robot.

Machine learning, and its branch named deep learning, has recently become a popular approach to processing all the data collected from sensors to enable the system to make intelligent decisions. Sitara AM5749 processors enable designers to run machine learning inference at the edge. Machine learning technology helps simplify programming and enables new ways to operate robots.

Software is also increasingly important in the development and deployment of robots and designers need an easy-to-use, flexible software platform to add features to their products as needed. Solutions like the Processor SDK (software development kit) allows designers to maximize their software reuse and migrate software across the TI processor portfolio.

The Processor SDK is a unified software platform for TI processors that enables quick setup and out-of-the-box access to benchmarks and demos. Additionally, specialized versions of the Processor SDK Linux include support for the ROS (Robot Operating System) framework utilized by developers of robot controllers.

Conclusion

There are a variety of system considerations a robotics designer has to make when designing a robot. Determining the central processor, system safety levels, sensors and software are all important when considering the application the robot is trying to address. When developing any robotics application, it's important to have options when evaluating system components. Scalable hardware and software solutions like Sitara processors or Hercules MCUs give designers the flexibility to create a variety of capable solutions for robotics.

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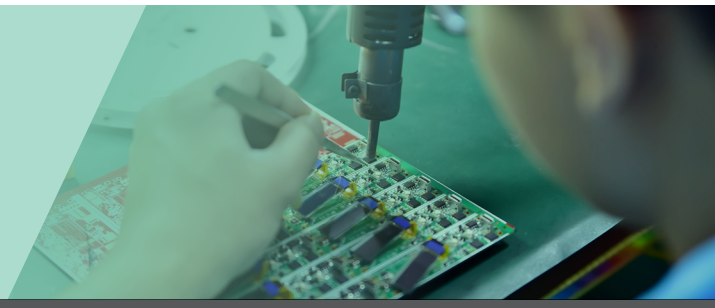
The development tools you need

Top 5 Development Tools



Mouser offers one of the widest ranges of development kits immediately available off-the-shelf to help designers get started. Here, Mouser's Technical Marketing Manager, EMEA, Mark Patrick, presents his 'Top 5 Pick' of recently-released dev kits.

www.mouser.com/Development-Tools-Center

Embedded Visionary

CrossLink-NX™ VIP Sensor Input Board

Lattice Semi's CrossLink-NX™ VIP Sensor Input Board enables designers to experiment with the embedded vision features of the CrossLink-NX Field Programmable Gate Array (FPGA). The CrossLink-NX VIP Sensor Input Board includes a CrossLink-NX, plus four Sony IMIX 258 CMOS MIPI image sensors, 3 Digilent Peripheral Module (Pmod™) interfaces, and a USB-B connection for device programming.

The CrossLink-NX VIP Sensor Input Board can be seamlessly integrated into the Embedded Vision Development Kit, providing multi-sensor connectivity for fast prototyping. Built on the 28nm FD-SOI Lattice Nexus platform, the CrossLink-NX family of FPGAs are optimized for a wide range of applications, including embedded vision, sensor and display bridging, sensor aggregation, sensor duplication, and AI inferencing at the Edge.

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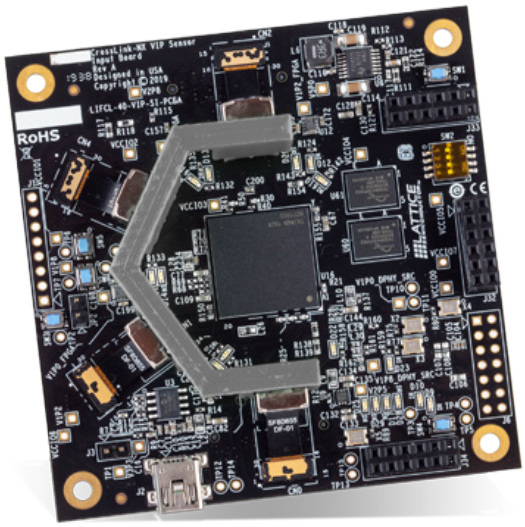

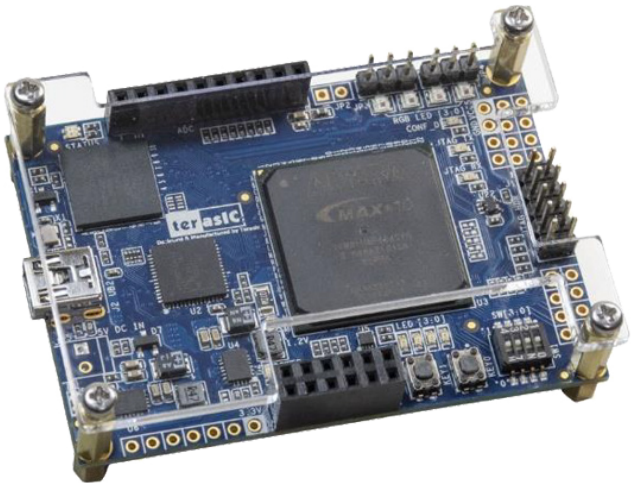

Learn RISC-V CPU/embedded design

Terasic Technologies T-Core FPGA MAX 10 Development Board

Terasic T-Core FPGA MAX 10 Development Board presents a robust hardware design platform built around the Intel MAX 10 FPGA. It is well equipped to provide cost-effective, single-chip solutions in control plane or data path applications and industry-leading programmable logic for ultimate design flexibility.

The T-Core development board includes hardware such as onboard USB-Blaster II, QSPI Flash, ADC header, WS2812B RGB LED, and 2x6 TMD expansion header. By leveraging all of these capabilities, the T-Core is the perfect solution for showcasing, evaluating, and prototyping the potential of the Intel MAX 10 FPGA. T-Core also supports RISC-V CPU with onboard JTAG debug. It is an ideal platform for learning RISC-V CPU design or embedded system design.

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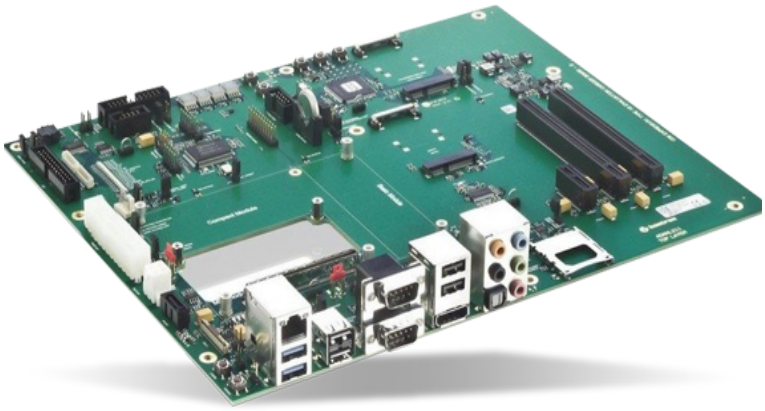
High performance SFF Computer-On-Module

Kontron COMe Evaluation Carrier2 T10



The Kontron COMe Evaluation Carrier2 T10 is designed to allow embedded application developers to get up and running quickly on the COM Express® Mini modular platform, giving them a head start on total system design.

The COMe Evaluation Carrier2 T10 offers interfaces for PCI Express, SATA, USB 2.0, LVDS, DisplayPort I, Gigabit Ethernet, and more. With a complete array of connectors brought out on this carrier board, it serves as a reference design for other more customized variations.

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Back to school

Arduino AKX00014 Physics Lab Kit

Arduino AKX00014 Physics Lab Kit provides comprehensive knowledge of electromagnetism, thermodynamics, kinetics, kinematics, and online educational materials for middle school teachers and students. This Arduino-based physics lab kit is fully compatible with the Google science journal on android. It is based on Arduino MKR WiFi 1010 and includes a range of sensors to measure light, temperature, motion, and magnetic fields. The AKX00014 physics-lab kit offers access to a set of props and online course content for teachers and students to conduct nine exciting science projects. Ideally, two students are recommended per kit to handle the projects that are mainly inspired by the popular fairground rides like the Gravitron and Pirate ship.

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Multimedia and GUI-centric

Mikroe Mikromedia 5 for STM32F7 CAPACITIVE

Mikroe Mikromedia 5 for STM32F7 CAPACITIVE is designed to facilitate rapid development of multimedia and GUI-centric applications. The device features a 5" TFT display with capacitive touch screen driven by the powerful graphics controller that can display the 24-bit colour palette (16.7 million colours). It also features a DSP-powered embedded sound CODEC IC that represents a perfect solution for any type of multimedia application. The device features 1MB of Flash memory and 192 + 4KB of SRAM (including 64KB of Core Coupled Memory). An Adaptive Real-time accelerator (ART Accelerator™) allows 0-wait state execution from Flash memory. OP

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Tech Tips

Solving BLDC Controller Design Challenges with the Qorvo PAC5556

By Robert Huntley for Mouser Electronics

Brushless Motors Gain Traction

Brushless DC (BLDC) motors have become the default choice of motor for a wide range of battery and line-powered equipment and appliances. More reliable and requiring significantly less maintenance than their brushed DC motor counterparts, brushless DC motors have also benefited from a broader industry understanding of how to control them using simple microcontroller algorithms. In today's complex and sophisticated control applications, brushed motors also create too much electrical noise, which means designers need to employ substantial electromagnetic immunity mitigation techniques.

Audible noise from brushed motors is also now considered undesirable, particularly for portable battery-powered appliances such as vacuum cleaners and personal power tools, including jigsaws and drills/drivers.

Manufacturers construct brushless DC motors using fixed permanent magnets on the rotor drive shaft and a series of field windings (typically three) on the inside of the motor casing. Switching the current through the three field windings in sequence results in rotation of the drive shaft. Controlling the pulse width and the switching frequency of the drive to each field coil provides control of motor speed, acceleration, and output torque. A closed-loop feedback of the rotor's operation to the three-phase motor control algorithm is required to closely monitor and control the current state of the drive shaft's rotation.

The two most popular methods of providing this feedback are:

- Affixing an encoder disk or other form of rotational sensor to the rotor shaft.
- Sensing the back electromagnetic field induced by the rotor's permanent magnets within the field windings. Field-oriented control (FOC) refers to using the induced field voltage.

A sensorless method helps improve overall motor reliability as well as reducing the bill of materials (BOM) cost.

The Architecture of a BLDC Motor Controller

As discussed in the section above, there are three distinct circuit functions required for a brushless motor controller. These three distinct circuit functions are achieved through:

- A microcontroller that runs the motor control algorithm
- Pulse Width Modulation (PWM) circuitry that provides the switching signals
- A power output stage that drives the motor

An analog-to-digital function converts the shaft rotational sensor signals into the digital domain for processing by the microcontroller. When designing an embedded motor controller, there are several design considerations. The initial factors that help shape the overall design of an embedded motor controller are:

- The power/torque required
- The power supply source
- The shaft speed

Today's fast-paced prototype-to-production focus tends to dissuade design engineers from developing a custom controller using discrete parts. Thus, the more popular design route is to use an off-the-shelf microcontroller to run the control algorithm. Most microcontrollers incorporate a wide range of ADC/DAC conversion functions in addition to different peripheral interface options, clocks, and timers.

"The integrated FPU supports complex high-resolution control algorithms, such as the ones used with FOC."

A suitably equipped microcontroller might provide the majority of the required circuit functions, but many microcontrollers tend not to be optimized for motor control applications or incorporate the necessary half/full "H" bridge motor drive functions. Also, energy management is a necessary function of most applications today and is especially important in motor control applications where the energy efficiency rating is usually a key selection criterion for customers. Power management ICs are available, but this requires the engineering team to integrate another IC into the design, increasing the BOM cost and board space requirements.

As more consumer and industrial motor-based appliances adopted a brushless DC motor design, the need for a device that includes all of the necessary functions drove Qorvo to develop a full-featured power application controller (PAC™). Qorvo's PAC5556 integrates all the required analog, power management, and gate drive signal sources within a single, compact package.

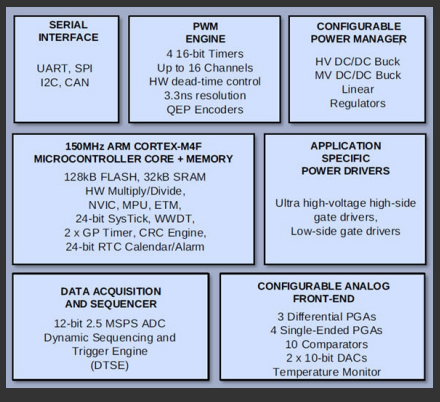

Figure 1: The image provides a simplified functional block diagram of the Qorvo PAC5556 power application controller. (Source: Qorvo)

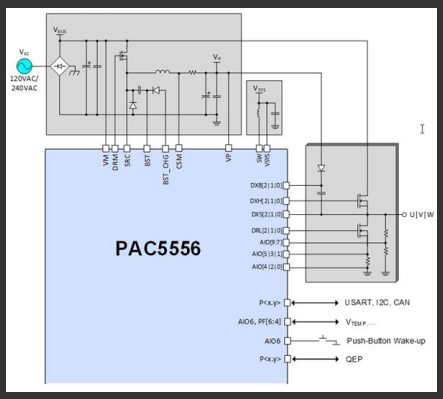

Figure 2: The image provides a simplified diagram of a Qorvo PAC5556 used to control a BLDC motor. (Source: Qorvo)

Introducing the Qorvo PAC5556

The Qorvo PAC5556 Power Application Controller® (PAC™) is supplied in a slim QFN-52 package, can operate motors up to 600VDC, and incorporates a comprehensive set of features and functions necessary for any BLDC or smart energy application (Figure 1).

The highly integrated PAC architecture makes the Qorvo PAC5556 especially well-suited for applications where the PCB is shrinking, such as white goods, compressors, and power tools.

A 150MHz 32-bit Arm® Cortex®-M4F microcontroller core with 128kB of user-programmable FLASH memory is at the heart of the device. A nested vectored interrupt controller (NVIC), capable of accommodating up to 25 external interrupts, provides a wake-up function to enable the device to come back from different sleep modes. Clock-gating of the 24-bit real-time clock permits low-power operation.

The microcontroller unit (MCU) also incorporates a high-speed 12-bit ADC. Configured for little endian operation, PAC5556's Arm® Cortex®-M4F microcontroller core includes hardware support for multiplication and division, DSP instructions, and an IEEE754 single-precision Floating Point Unit (FPU). The integrated FPU supports complex high-resolution control algorithms, such as the ones used with FOC. The high-performance features of this MCU enable design engineers to easily implement complex real-time algorithms, safety software, and diagnostics in their applications.

A pulse-width modulation (PWM) engine provides the drive signals for the motor gate drivers. Capable of fine motor control, down to 10ns, the PWM engine consists of four 16-bit timers and 14 channels.

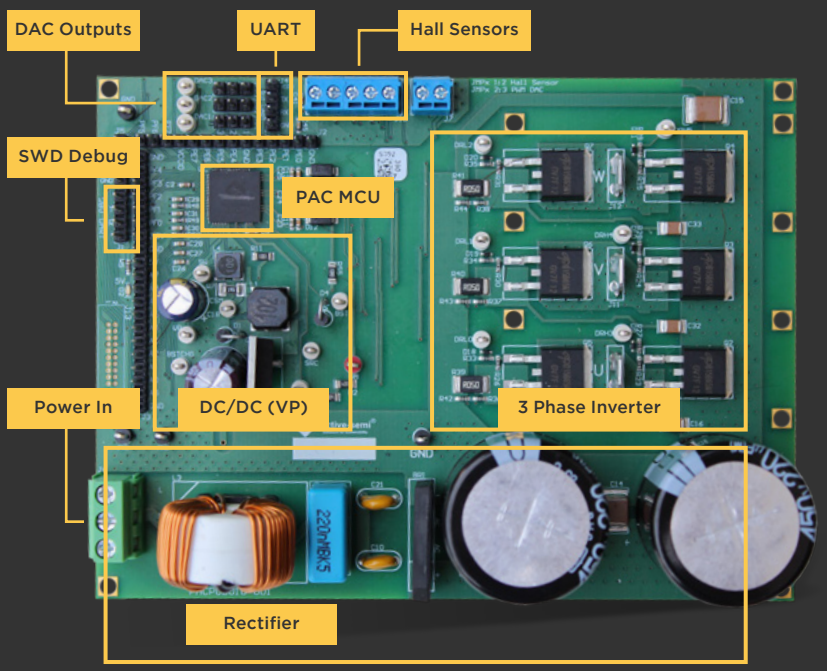

Figure 3: The Qorvo PAC5556EVK1 evaluation board. (Source: Qorvo)

The analog front end of the PAC5556 is highly configurable and offers both differential and single-ended programmable gain amplifiers, ten comparators, 10-bit DACs, programmable over-current protection, integrated VM ADC sampling, and I/Os for inter-connectible and programmable signal sampling, feedback amplification, and sensor monitoring of multiple analog input signals. These analog capabilities make the device suitable for use in field-oriented control or sensor-based BLDC control applications.

Other salient attributes of the Qorvo PAC5556 include a configurable power manager and application-specific power drivers.

The configurable power manager contains a multi-mode switching supply converter that permits the IC and the motor drive circuits to be powered using a buck converter topology. On-chip linear regulators provide the IC supply rails, and the power management functions control the available sleep and hibernate modes. Designers can optimize the power manager for run-time and standby modes. PAC's very small standby current results in very good battery life in battery-powered tools when not in use. In equipment that is always connected to an AC (like white goods), the power manager can help with ENERGY STAR ratings. The power driver block provides all the necessary high- and low-side gate drivers suitable for use in a variety of different motor drive configurations, including half-bridge and full "H" bridge.

A simplified diagram of the Qorvo PAC5556 used to drive a BLDC motor is illustrated in Figure 2.

To aid the prototyping and development process, an evaluation board based around the Qorvo PAC5556 is available. The Qorvo PAC5556EVK1 is a complete fully-featured evaluation and prototyping platform for the PAC5556 (Figure 3).

The evaluation board supports gate driving for up to three half H-bridge inverters with ratings up to 220VAC or 450VDC. A virtual COM port connection to a computer together with a GUI-based software suite permits configuration and control of any application running on the PAC5556EVK1.

Conclusion

Brushless DC motors have become a popular choice for use in a wide range of consumer and industrial appliances. As brushless motors are incorporated into a broader range of applications, the ability to quickly design, prototype, and test motor controllers is key to speeding the overall product design process. As a result, design engineers need a device that integrates all the required analog, power management, and gate drive signal sources within a single package. The highly integrated Qorvo PAC5556 Power Application Controller meets the need for a compact power control solution that reduces energy consumption, bulk, and noise in consumer and industrial motor applications. This design also meets tighter board space requirements and keeps the BOM cost to a minimum.

Ultra-small proximity sensor extends charge time in hearables

The 2-in-1 TMD2635 IR proximity detection module from ams incorporates a 940nm infrared vertical cavity surface emitting laser (IR VCSEL) and is factory calibrated for IR proximity response.

The proximity detection feature provides nearby object detection using photodiode detection of reflected IR energy sourced by the VCSEL. The TMD2635 module offers advanced crosstalk noise cancellation through a wide range of offset adjustments to compensate for unwanted IR energy reflection at the sensor. These sensor modules optimize sensitivity, power consumption, and noise. Typical applications include true-wireless stereo earbuds, display backlight control, and optical switch.

Applications for the ams TMD2635 IR proximity detection module include power control and volume control in true-wireless stereo earbuds, watches, and other wearables; display backlight control; and optical switches.

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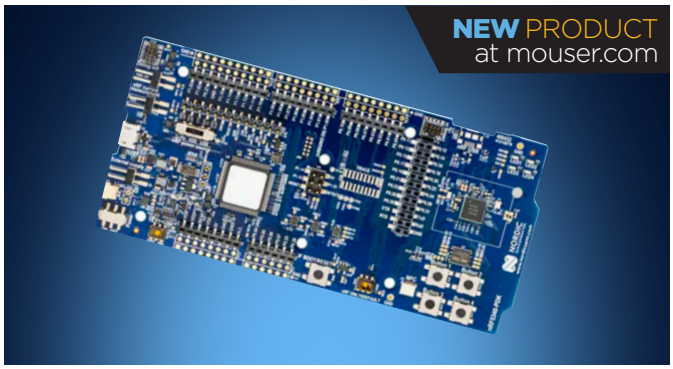


Nordic dev kit features next-gen dual Cortex-M33 SoC

The Nordic nRF5340 PDK incorporates the nRF5340 SoC and contains everything needed to get started with development on a single board. The nRF5340 SoC combines a high-performance Arm Cortex-M33 application processor with a fully programmable and ultra-low-power network processor.

Nordic Semiconductor's nRF5340 PDK supports development with an extensive range of wireless protocols. The kit supports Bluetooth 5 features such as long range (LoRa), 2Mbps, and advertising extensions. Mesh protocols like Bluetooth mesh, Thread, and Zigbee can be run concurrently with Bluetooth Low Energy. This enables smartphones to provision, commission, configure, and control mesh nodes. The kit also supports NFC, ANT, 802.15.4, and 2.4GHz proprietary protocols. Applications for the nRF5340 PDK include professional lighting, industrial systems, wearables, medical devices, smart home, and asset tracking and real-time location systems.

Click for More Information

16-bit SAR ADCs feature high 4 MSPS throughput

Single-ended and function-compatible with AD7380 and AD7381 ADCs, the 16-bit AD7386 successive-approximation register (SAR) ADC from Analog Devices features a throughput rate of 4 Mega Samples per second (MS/s) in a tiny 3mm × 3mm LFCSP package. The dual simultaneous-sampling, high-speed ADC is ideal for motor control, sonar, power quality, and data acquisition applications.

Available from Mouser Electronics, the Analog Devices AD7386, contains two SAR ADCs, a multiplexer, a sequencer, and a serial interface with two separate data output pins. Engineers can access data on the device via the serial interface, which can operate with one or two serial outputs.

The ADC features single-ended analog inputs and operates from a 3.0V - 3.6V power supply, with a buffered internal 2.5V reference (optional external reference up to 3.3V) and typical drift of just ±1 ppm/°C.

Click for More Information

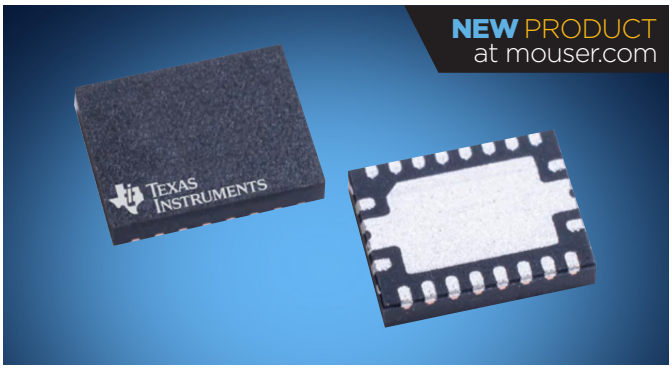
Chip includes both CAN FD controller and transceiver

Supporting data rates of up to 5Mbps per second with up to 18MHz SPI clock speed. The TCAN4550 and TCAN4550-Q1 controller area network with flexible data rate (CAN FD) controllers from Texas Instruments (TI) are industry's first system basis chips to integrate a controller and transceiver for CAN FD.

The highly integrated controllers are ideal for use in building automation, industrial transports, and factory automation, and the TCAN4550-Q1 version is AEC-Q100 qualified for use in automotive applications.

Available from Mouser, the ICs deliver differential transmit capability to the bus and differential receive capability from the bus. The controllers boast wide CAN BUS operating ranges, including ±42V bus fault protection and ±12V common mode. The chips provide an interface between the system processor and the CAN bus using a serial peripheral interface (SPI), offering support for both CAN FD and classical CAN.

Featuring multiple operating modes, including standby and sleep, the controllers offer low power consumption through the use of wake and inhibit features.



Capable of supporting the bandwidth and data flexibility requirements of in-vehicle networks, the controllers can implement a CAN FD interface on a system using the SPI bus of nearly any microcontroller.

The TCAN4550 controllers are supported by the TCAN4550EVM evaluation module, which can be connected to any microcontroller or SPI controller with an I/O voltage of 3.3V or 5V using a standard interface header.

Featuring an EMC-filtered and polarity-protected supply voltage, the evaluation module is capable of operating using an external voltage range of 6V to 24V.

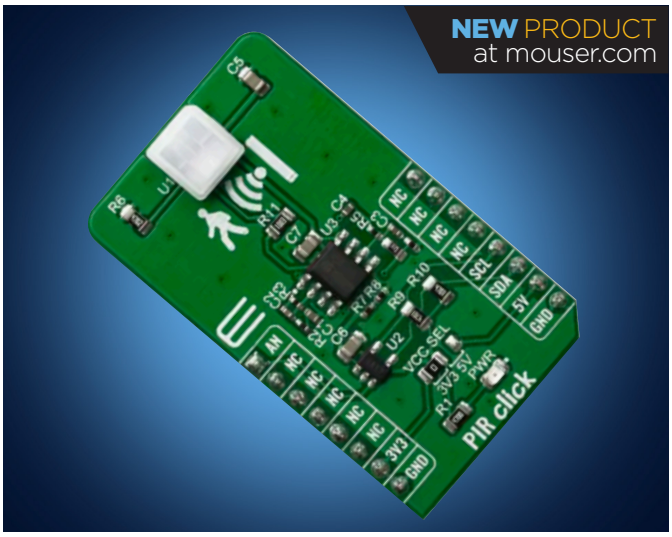
Click for More Information

Click board has PIR sensor for human presence detection

Mouser is now stocking the PIR Click board from Mikroe. The PIR Click is a pyroelectric sensor supporting human presence detection for a range of consumer electronics and IoT applications.

The board is equipped with an onboard PL-N823-01 pyroelectric proximity infrared (PIR) sensor from KEMET Electronics, which enables human detection through glass or resin. The high-performance sensor is an ideal solution for applications such as office automation, contactless switching, lighting, air conditioners, and other consumer products.

Available from Mouser Electronics, the PIR Click board generates voltage when exposed to infrared radiation from human bodies. The low-power sensor is passively triggered by moving subjects, enabling it to deliver energy-saving performance in applications relying on human presence detection. The board includes a white plastic Fresnel lens that filters visible light, allowing the sensor to detect the infrared signature emitted by humans. The onboard PL-N823-01 PIR sensor boasts KEMET's proprietary piezoelectric ceramic material and element structure, resulting in greater freedom of design for products using resin or glass.



The PIR Click board is part of the Mikroe Click Board ecosystem, a modular design that enables developers to connect any Click board to a standardized mikroBUS socket with no hardware configuration required. The versatile mikroBUS standard socket contains all necessary pins to connect Mikroe's complete range of Click boards, including wireless communication modules, sensor modules, and other accessories.

Click for More Information

Ultra-small SoC suits medical disposables

The low-power, cost-effective DA14531 SmartBond TINY SoC from Dialog Semiconductor is the industry's smallest and most power-efficient Bluetooth 5.1 SoC, enabling new classes of IoT devices, including the growing market for connected medical products.

Available from Mouser Electronics, the SoC achieves a low system cost through a high level of integration. It is based on an Arm Cortex-M0+ microcontroller with a complete set of analogue and digital peripherals, and incorporates a 2.4GHz transceiver in a minuscule form factor of just 2.0mm × 1.7mm. By adding just six external passives, a crystal oscillator, and power source, designers can build a complete Bluetooth Low Energy system for applications such as asset tracking, RFID tags, beacons, wearables, medical, and automotive applications.

Mouser also stocks the DA14531 SmartBond TINY dev kits in Pro and USB versions.

The DA14531 Pro includes a Bluetooth Low Energy motherboard, daughterboard with the DA14531 SoC, and a mini-USB cable. The kit›s extensive features include two mikroBUS header interfaces, Arduino Uno compatibility, and onboard 2-Mbit SPI data flash. It allows users to perform RF measurements using an embedded printed antenna and SMA connector capability. The DA14531 USB dev kit is a small, portable USB board with Bluetooth Low Energy technology, one mikroBUS connector, 2-Mbits of SPI flash, and an onboard DA14531 SoC.

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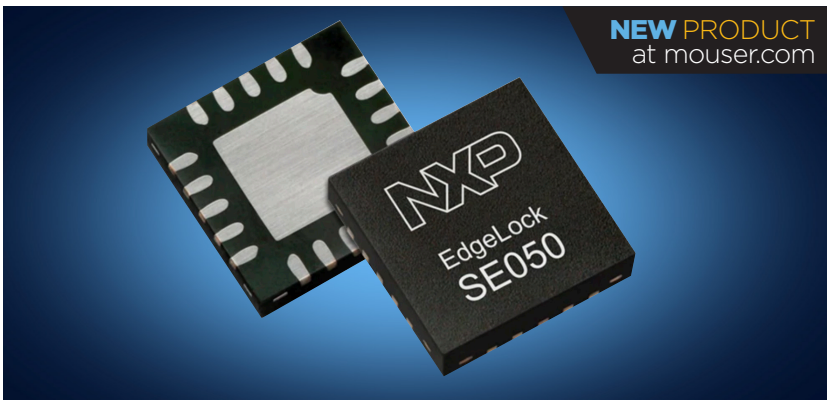

Highly secure for IoT applications

Mouser is now stocking the EdgeLock SE050 Plug & Trust secure element from NXP Semiconductors.

The chip offers Root of Trust at the IC level, giving IoT applications state-of-the-art, edge-to-cloud security capability right out of the box. EdgeLock SE050 offers enhanced Common Criteria EAL 6+ security certification up to the OS level. The SE050 also supports both RSA and ECC asymmetric cryptographic algorithms with high key length and future proof ECC curves. The latest security measures protect the IC against sophisticated non-invasive and invasive attack scenarios. Delivered as a ready-to-use, turnkey solution, the EdgeLock SE050 includes a complete product support package that reduces time to market.

Applications for the EdgeLock SE050 Plug & Trust secure element include home and building control, smart cities, smart home, industrial, smart industry, and smart supply chains.

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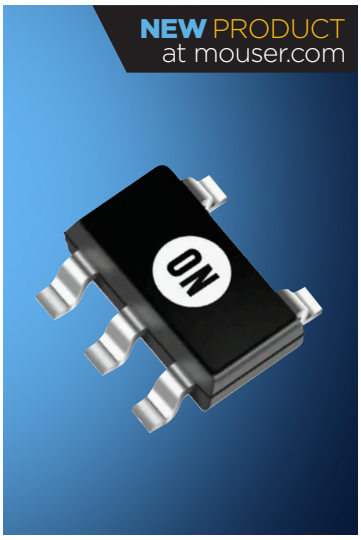
High-Performance CMOS op amps



ON Semiconductor's high-performance CMOS op amps are available in a wide range of general-purpose, low-power, and precision families of single, dual, and quad devices.

The op-amps offer lower power and higher accuracy operation over traditional bipolar amplifiers, especially in terms of input bias current, quiescent current and input offset voltage.

Applications for the op amps include automotive, battery-powered instruments, current sensing, electronic scales, lighting, medical instrumentation, sensor signal conditioning, temperature monitoring, transducer applications, and unity-gain buffer.

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Qorvo/Cypress USB-C charging design

Mouser presents a new USB Type-C charging hub reference design from Qorvo and Cypress Semiconductor to help engineers speed their design and development time.

The design includes the Qorvo ACT4751 DC-to-DC buck converter and a Cypress EZ-PD CCG3PA USB Type-C and power delivery (PD) controller. The products and reference design support applications such as PC and tablet power adapters, smartphone and mobile chargers, vehicle chargers, and power banks.

The Qorvo ACT4751 is a high-efficiency, synchronous step-down DC-DC converter with a wide 4.5V - 40V input range. The ACT4751 employs a proprietary control algorithm and controls two integrated 50mΩ MOSFETs to achieve very high efficiency and enable extremely compact designs.

The Cypress EZ-PD CCG3PA controller supports USB-C power source and dual-role power source/sink. Additionally, the controller fully supports the USB PD 3.0 Programmable Power Supply (PPS) specification, which allows smartphones to communicate with the charger to determine the ideal voltage and current levels. The controller's Quick Charge 4 certification also incorporates improved safety features to ensure fast charging without overheating.

Together, the ACT4751 converter and CCG3PA controller form the basis of a USB-C/USB-A charging power hub reference design.

The solution is a receptacle-based Type-C power adapter that supports a maximum power profile of 80W (20V, 4A), along with a legacy Type-A port with a maximum output of 60W (20V, 3A when activating Quick Charge 3).

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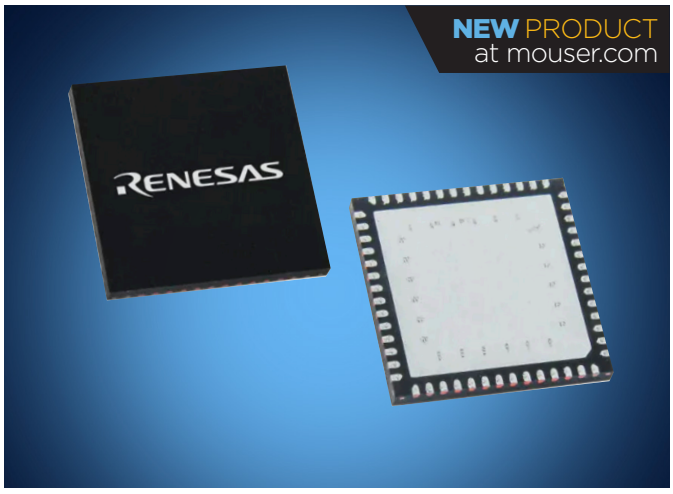
MCU has security for Bluetooth 5 Endpoints

The Renesas RX23W microcontroller integrates full Bluetooth 5.0 Low Energy connectivity with a high-performance 32-bit RXv2 CPU core, plus FPU and DSP functions. The device integrates Renesas' Trusted Secure IP (TSIP) as part of its built-in hardware security engine.

The TSIP driver uses strong encryption key management with hardware accelerators to securely boot customers' IoT devices and protect them from security threats.

The RX23W features a broad range of peripheral functions that are indispensable for IoT equipment, including security, touch key, USB, and CAN functions. These functions allow the RX23W to implement both system control and Bluetooth wireless functions for IoT endpoint equipment such as home appliances, healthcare equipment, and sports and fitness equipment on a single chip.



In addition, the RX23W's Bluetooth mesh functions make it optimal for industrial IoT equipment collecting sensor data within a factory or a building.

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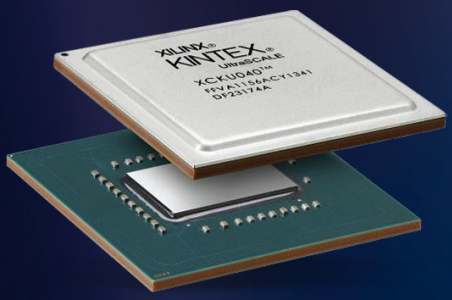

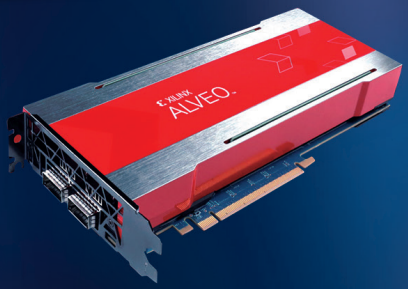

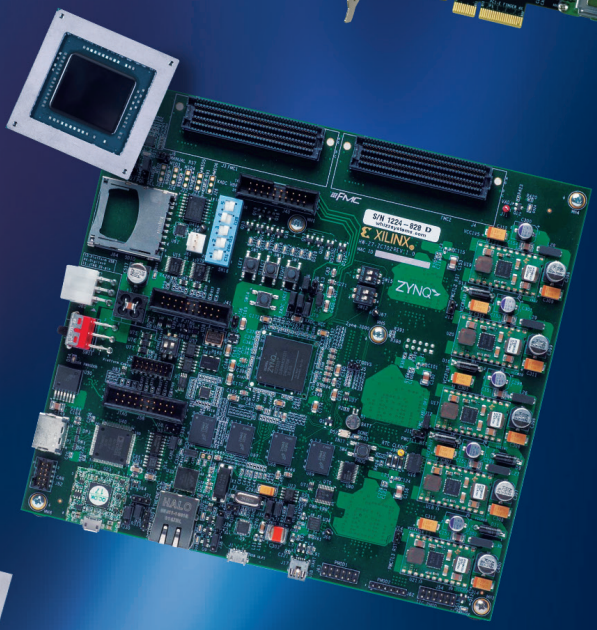

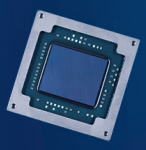

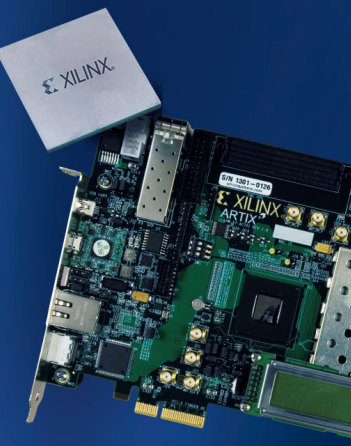

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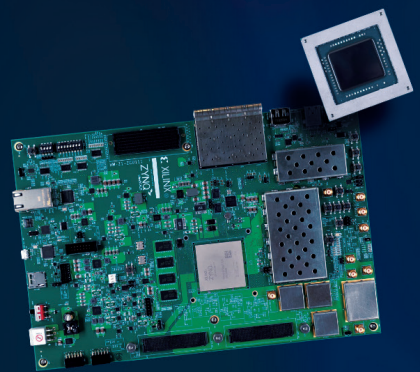

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