



X-ray vision

Medical manufacturer realizes market potential of portable X-ray device based on Kontron's SMARC-sXAL4

Turner Imaging Systems

Utah, USA

Project:

Portable X-ray vision

Kontron Platform:

SMARC-sXAL4

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Turner Imaging Systems, headquartered in Utah, USA, is a leading developer of technologically advanced ultra-portable X-ray imaging systems.

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In 2020, the company launched the SMART-C® fluoroscopic Mini C-Arm. This is the world's first truly portable fluoroscopy (live X-ray) solution. It was born out of the need for on-site imaging in the aftermath of the catastrophic earthquake in Haiti in 2010. Dr. Clark Turner - a serial entrepreneur and a Ph.D. in Analytical Chemistry - had developed the Nomad hand-held dental X-ray source in his previous company. Still, the Nomad could not satisfy the need for medical imaging that was in demand following the catastrophe. Dr. Turner would then visualize what would later be realized in the SMART-C®.

Since launch, the SMART-C® has quickly gained traction to become the alternative to the nearly 400-pound systems common in most hospitals. Its image quality matches the traditional, larger X-ray machines but can be hand carried wherever and whenever needed due to its 16-pound weight. Moreover, its high performance and versatility have enabled the SMART-C® to disrupt the medical industry in a growing number of use cases, including in the operating room, ambulatory surgical centers, orthopedic clinics, clinical labs, sports teams, and humanitarian missions.

Project Requirements / Challenges

Turner Imaging Systems' vision for the SMART-C® was to satisfy the gap in the medical systems market demand for a versatile and genuinely portable X-ray device, capable of addressing a wide range of use cases, including:

- › Orthopedic surgery
- › Orthopedic clinics
- › Sporting events
- › Humanitarian events
- › Hospitals
- › Military
- › Veterinary clinics
- › Medical education (surgeon training)

Key to the success of the SMART-C® has been the choice of embedded computer technology utilized: for enabling a compact, mobile, and low-power usage device without compromising performance and usability. The following application article discusses the design challenges, the solution choice, and the subsequent results and benefits achieved.



To achieve its aim, the company's product design challenge centered on ensuring the SMART-C® could run 2.4 million pixel images through advanced algorithms at 10 frames per second. This entailed moving approximately 4.8 MByte of images from the PCIe imaging module into CPU memory for compression before their wireless transmission to a display tablet.

Turner Imaging recognized that this level of computing power would require a processor operating at a minimum speed of 2.4 GHz and having at least four cores. Further prerequisites were overall device power consumption, which needed to be under 10 W, and a compact form factor that could fit within the confined space of the product device, measuring just 6" x 4" x 2".

To ensure a rapid and low-risk approach to bringing its pioneering X-ray solution to market, Turner Imaging recognized that partnering with a trusted long-term supplier for Computer-On-Modules (COMs) was essential. Compared to full custom designs, they offer a faster, more flexible, and highly scalable solution with the benefit of making future processor upgrades much easier. And compared to commodity PC motherboard alternatives, they ensured maximum reliability and durability, backed by extended product lifetime guarantees.

The chosen supplier would also ideally be highly experienced in the specialized embedded computing requirements of the medical sector. A global logistics and support capability was also preferable, in line with Turner's plans for scaling up production of their new product and future international expansion strategy.

Key Design Factors

- › High processing performance
- › Compact footprint
- › Low power
- › Lightweight

Additional considerations:

- › Ruggedness
- › Ease of software integration
- › Time to market
- › Cost-effectiveness and long lifecycle
- › Regulatory considerations



Having looked at different modules, we chose Kontron because their SMARC™ module optimized size and power – it was the best in compactness and performance. Their customer service was also very impressive. Working with Blake Nicholson (Luscombe Engineering-Utah), who put us in contact with Joe Nicosia, John Landes, and others, we identified the specification needed for the product. They really worked hard to help our team resolve the technical issues that came up.

Tom Youd, VP of Engineering at Turner Imaging Systems



In 2016, following a review of potential embedded computing suppliers, Turner Imaging selected Kontron following an introduction via their local manufacturer representative, Luscombe Engineering, Utah.

The Kontron sales, customer support, and technical teams liaised closely with Luscombe Engineering and Turner Imaging to review and identify the exact system requirements.



Solution

Kontron subsequently specified its SMARC-sXAL4, configured with the Intel N4200 SoC. This was the optimal solution as it offered a small footprint and low power CPU consumption without compromising processing performance. Furthermore, the SMARC (Smart Mobility ARChitecture) small form factor open standard defined by SGET (Standards Group for Embedded Technologies) was largely pioneered by Kontron and offered a comprehensive portfolio of SMARC products with Intel® x86 and Arm® processors.

The Kontron SMARC-sXAL4 Module also allowed a cost-effective fanless design, balanced processor, and graphics performance. In addition, long lifecycle and general performance and I/O requirements were easily addressed by the industry standard SMARC™ module. This choice of Module also made sense because the SMARC design readily supported the Windows 10 embedded O/S that Turner planned to use.

Project Delivery

Kontron also provided a SMARC evaluation carrier board to facilitate the initial development stage until Turner had completed their custom carrier design, which Kontron reviewed to ensure their new device performed as planned.

"From the outset, Kontron's technical engagement with Turner Imaging Systems was extremely cooperative as problems or challenges came up," asserts Joe Nicosia, Sales Manager for Industrial Automation at Kontron.

"We felt that it was a mutual responsibility and positive engagement between the teams to resolve the issues. As a result, we felt we walked away with learning more about what is important to Turner for a successful product and how we could provide what was needed to fill the need."

Results

The Kontron hardware and software solutions met all program design and performance objectives:

- › Processing & graphics performance
- › Low power, lightweight
- › Compactness
- › Speed to market
- › Industry-standard:
 - Alignment with regulatory requirements
- › Software compatibility

Benefits

With the help of Kontron SMARC™ modules and embedded computing expertise, Turner Imaging was able to build and rapidly bring to market its game-changing portable X-ray device. As a result, the SMART-C® is now enabling the company to exploit major new and varied market opportunities in the healthcare market.



The cordless, battery-powered, 16-pound ultra-portable SMART-C® is unparalleled in providing high-quality X-ray imaging virtually anywhere and anytime.

- › Offers point-of-care imaging to accelerate diagnosis, treatment planning, and recovery
- › Provides workflow efficiencies and optimizes patient-physician communication in the clinical setting
- › Enables sideline diagnosis for professional and collegiate football and baseball teams; facilitating rapid return-to-play decisions and treatment planning
- › Removes the queue for radiology
- › Enables surgeons to perform more procedures in the clinic
- › Allows diagnosis and surgical procedures to be performed in locations lacking stable power and X-ray equipment

"Kontron has been a fantastic partner in providing a competing solution that offers excellent performance and power efficiency in a compact space," concluded Turner's Tom Youd.

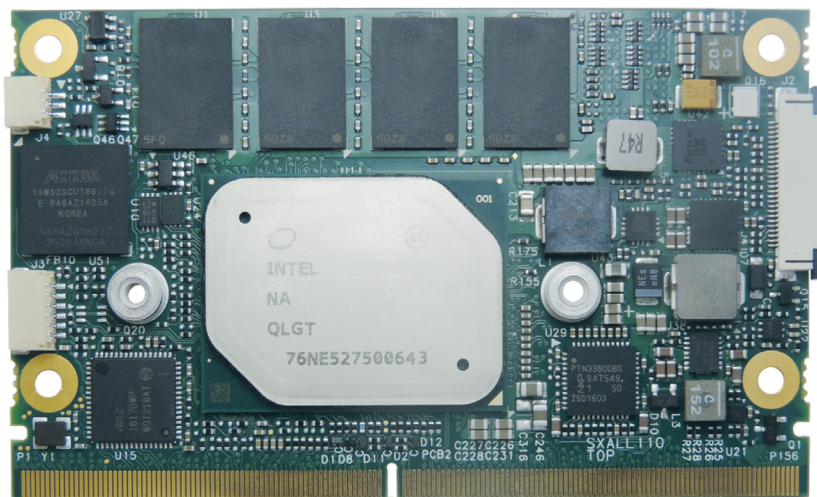
Kontron's Joe Nicosia added: *"Turner was always upfront and open to what stage they were in their development, certifications, and business expectations. As a result, I knew that I could always go back to my management and felt confident that my message was accurate to expectations."*

"Kontron is also especially proud of the fact that our manufacturer's representative, Blake Nicholson, Luscombe, was always in-sync with Turner's needs. He was always proactive and in step with what was happening at their site and ensured we knew what was critical for our mutual success."



➤ To learn more about how SMART-C® is revolutionizing point-of-care imaging and enabling orthopedic surgeons to perform more minimally invasive procedures in the clinic, visit: www.turnerxray.com


Kontron SMARC-sXAL4 Intel® Apollo Lake Module



SMARC-sXAL4
Intel® Apollo Lake Module

Kontron SMARC-sXAL4

- ▶ 82 mm x 50 mm module – approximately the size of a credit card
- ▶ Intel® N3350 Celeron (low end Intel® Apollo Lake, from Intel Atom® line)
- ▶ 2 GByte LPDDR4 DRAM, on the module
- ▶ 4 GByte eMMC for OS and application program storage on the module
- ▶ 2x USB 3.0 used for debug and software updates
- ▶ Single or dual channel LVDS flat panel display output
- ▶ HDMI (available for debug use in this case)
- ▶ 2x Gigabit Ethernet (one available for debug in this case, other not used)
- ▶ Other SMARC I/O (PCIe, SATA, I2C, GPIO, serial ports etc, some used)
- ▶ Kontron orderable part number 51012-0204-11-2

 More information:
SMARC-sXAL4





About Kontron

Kontron is a global leader in IoT/Embedded Computing Technology (ECT) and offers individual solutions in the areas of Internet of Things (IoT) and Industry 4.0 through a combined portfolio of hardware, software and services. With its standard and customized products based on highly reliable state-of-the-art technologies, Kontron provides secure and innovative applications for a wide variety of industries. As a result, customers benefit from accelerated time-to-market, lower total cost of ownership, extended product lifecycles and the best fully integrated applications.

For more information, please visit: www.kontron.com



Your Contact

Kontron America Inc.

9477 Waples Street
San Diego, CA 92121, USA
Tel.: +1 888 294 4558
sales@us.kontron.com



Global Headquarters

Kontron Europe GmbH

Gutenbergstraße 2
85737 Ismaning, Germany
Tel.: +49 821 4086-0
info@kontron.com

www.kontron.com

