Technical White Paper

Leveraging COM Express for Medical Equipment Design

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Modern day medical applications have a wide spectrum of needs from the demanding computing requirements of optical imaging technologies—such as magnetic resonance imaging (MRI), optical coherence tomography (OCT), x-ray computed tomography (CT) and computed axial tomography (CAT) scans, and 3D ultrasounds—to the compact form factor and low power consumption necessary for mobile diagnostic equipment. As the needs vary drastically from application to application, medical equipment designers can benefit from the scalable architecture and flexibility of Computer-on-Module (COM) Express systems. With COM Express (COMe), equipment designers can directly deploy the COM onto their I/O boards as ready-made components. Since medical applications also deal with human life, the equipment deployed also requires the highest safety and reliability standards.

This paper discusses the key factors medical equipment designers need to consider when developing solutions for a wide variety of application requirements, and how the agility and reliability of COM Express systems address these concerns.

Considerations for Designing Medical Equipment

Although patients may only see the scanners doctors use to capture diagnostic data, transforming detailed x-rays and images scanned from these complex imaging systems into actionable information to diagnose and treat patient illnesses requires substantial processing power. Of course, not all medical applications require the same level of computing performance. In fact, some equipment, such as endoscopes, computer-assisted surgical equipment, and other devices are designed to be operated in the skilled hands of a physician and require portability over computing prowess. So what precisely should medical equipment designers consider when developing solutions for such a wide range of applications?
All-in-one design vs. ready-made embedded systems

In the past, medical equipment designers would use custom-built all-in-one motherboards. Designers would choose a microprocessor or microcontroller chip, design the supporting circuitry around the chip, and add any specialized inputs and outputs (I/O) required by the particular application. An all-in-one design gave designers a great deal of control over exactly what features were included in the final design. Every part of the circuit in a fully customized design is there for a reason specific to the end application. However, fully customized designs can take substantial time to get from the drawing board to the market.

COM Express (COMe) solutions, on the other hand, provide a more modular alternative to traditional all-in-one motherboards. When choosing a COM Express solution to integrate with their own I/O boards, equipment designers can increase the speed of product design and improve time-to-market efficiency. Since COMe systems can easily integrate with 80% of I/O boards, equipment designers are free to focus on the I/O board design without having to worry about the x86 architecture of the chip. By selecting ready-made COMe and deploying it on a customized I/O board for a particular customer, medical equipment designers can focus on their core competency in designing the I/O board to fit the needs of target applications. By enabling equipment designers to add different components to an I/O board to support additional functionality, COMe provides additional flexibility in design.

Form factors and performance requirements for a range of applications

Equipment designers also need to take form factor into consideration when designing for medical applications. Advancements in optical imaging technologies have helped doctors to diagnosis innumerable conditions and save countless lives. However, these technologies also have demanding—and growing—computing requirements. For complex imaging applications such as these, COM Express Basic & Compact modules offer highly scalable computing and graphics performance that enable equipment designers to create application-ready, widely usable product families. If the application requires mobility over processing power, the small size and low energy consumption of COM Express Mini modules provide the perfect fit for next-generation ultra-compact portable medical devices. These devices require considerably less processing power than large-scale MRI machines or other medical imaging technologies.

Consequently, medical equipment designers also need to match computing performance to the target medical application needs. Although entry-level CPUs are sufficient and help reduce power consumption for portable equipment, complex imaging technologies generally require high-end CPUs with greater processing power. For example, producing high quality images from MRI, OT, CT, and CAT scans for doctors to properly identify anomalies in their patients requires higher computing performance or even a discrete GPU to process massive amounts of data at high speeds. What’s more, doctors may even use a number of different medical diagnostic software and hardware that require additional processing capacity across heterogeneous platforms.

To address these concerns, medical designers may select COM Express systems that support Open Computing Language (OpenCL) or Open Graphics Library (OpenGL) platforms to provide performance enhancements for medical applications. As the names suggest, OpenCL and OpenGL are royalty-free standards that allow designers to develop parallel processing software that is compatible with CPUs, GPUs, digital signal processing (DSP) units, and field-programmable gate arrays (FPGAs) from many
different manufacturers. Alternatively, designers may also choose to use a discrete GPU, such as Nvidia’s CUDA platform to achieve accelerated image processing.

**Critical medical concerns**

Since doctors rely on the devices and applications developed by medical equipment designers to diagnose and treat life-threatening illnesses, medical applications understandably have a unique demand for the highest product safety and reliability standards that comply with strict regulations. In particular, ISO-13485 dictates the global quality standards for designing and manufacturing medical devices and should be an expectation for any medical equipment designer to meet.

Besides compliance with medical regulatory requirements, equipment designers must also deliver uncompromised system reliability, expertise, and product longevity of typically seven years. After all, medical equipment are both instrumental tools that cannot be easily replaced as well as substantial financial investments for hospitals and clinics. Moreover, the long amount of time required to obtain approval for devices that operate in critical environments, especially those involving human lives, from the U.S. Food and Drug Administration and regulatory bodies in other jurisdictions necessitates above-average device reliability.

**ARBOR Solutions**

With over 25 years of experience in designing embedded systems, ARBOR has the proven knowledge and expertise that equipment designers rely on for medical application development. In fact, ARBOR even offers a designated medical product line that is specifically developed to meet the unique demands and needs of the medical sector. As an ISO-13485 certified company, medical equipment designers can rest assured that ARBOR products meet the requisite quality standards for medical devices used in critical environments involving human life.

What’s more, ARBOR is also ISO-14971 certified to effectively ensure the safety of medical devices during the entire product lifecycle. In fact, the nine-part ISO-14971 standard is even more rigorous than the ISO-13485 standard and covers risk analysis, evaluation, control, management, and comprehensive procedures for reviewing and monitoring during production and post-production. Consequently,
ARBOR’s medical-grade COMe modules offer longevity well beyond the industry standard, providing 10- or even 15-year lifecycle support for selected modules.

**ARBOR COM Express Products**

ARBOR Technology specifically offers the following product solutions to help equipment designers satisfy a wide range of medical application requirements.

- **10 to 15 Years Product Longevity**

<table>
<thead>
<tr>
<th>15-Year Longevity</th>
<th>10-Year Longevity</th>
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<tr>
<td>EmETXe-i90U0-7600U</td>
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- **Complete computing requirements**

  ARBOR’s COM Express modules support Intel® 2nd, 3rd, 4th, 5th, 6th, and 7th generation core processors, as well as AMD’s G-series & R-series platforms.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Intel® 2nd ~ 7th generation core processors</th>
<th>AMD G-Series</th>
<th>AMD R-Series</th>
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<tbody>
<tr>
<td>Performance</td>
<td>Entry to high level computing</td>
<td>Optimized for power efficiency</td>
<td>Optimized for performance</td>
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- **Selectable form factors**

  ARBOR modules are available in several form factors for agile deployment.

<table>
<thead>
<tr>
<th>Form Factor</th>
<th>Mini Type</th>
<th>Compact Type</th>
<th>Basic Type</th>
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<tbody>
<tr>
<td>Size</td>
<td>84x55 mm</td>
<td>95x95 mm</td>
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<td>ARBOR Offerings</td>
<td>EmNANO series</td>
<td>EmETXe series</td>
<td>EmETXe series</td>
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</table>
High flexibility for diverse applications

Easy integration with multiple I/O, storage, display, and expansion interfaces enables limitless possibilities.

Conclusion

Medical equipment designers have a lot on their plate when it comes to developing life-saving solutions for doctors and healthcare providers. COM Express modules offer an efficient and highly effective solution that addresses the key factors equipment designers need to consider when developing equipment for medical applications. First, ready-made COM Express modules enable faster time-to-market while still offering sufficient flexibility for designers to customize I/O board designs for a broad spectrum of highly specialized applications from optical imaging to portable diagnostics. Embedded COM systems are also available in multiple form factors and support a wide range of computing performance requirements. Last but not least, ARBOR’s COM Express solutions that meet the rigorous regulatory requirements for medical devices are already available, ensuring uncompromised product reliability and safety. From highly portable medical equipment to advanced MRI, OT, CT, and CAT scan machines, COMe modules are agile enough for any I/O board used in cutting-edge medical applications.

More Information

For more information on ARBOR’s COM Express embedded computing solutions, please [click here](#).