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THE HOSPITAL OF THE FUTURE

How AI And IoT Revolutionize Healthcare

By Kontron S&T Group

▶ E-BOOK

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Chapter 1

Healthcare and the Embedded Cloud

Digitalization is gaining momentum in medicine and healthcare. Digital applications have great potential for the prevention, diagnosis and therapy of diseases. In addition, digitized processes can be used to optimize ongoing treatments. This starts in the general practitioner's practice and extends to the hospital if treatments or even operations should become necessary there. Digitalization leads to leaner and more transparent processes in the healthcare sector. This results in cost reductions, faster and more well-founded diagnoses, improved treatment quality and, finally, better utilization of resources and equipment.

IoT revolutionizes network infrastructure in hospitals

Modern medical care is based on smart real-time applications. IoT and the associated focus on networking, security, scalability and sustainability play a decisive role, especially in the hospital environment.

A hospital is a complex structure, in which various administrative tasks are integrated as well as different treatment processes, some of which extend across various medical departments. To ensure smooth processes, data must be collected, processed and kept in stock. Low latencies as well as fast analyses and decision options on site are essential for doctors and nursing staff. An important criterion is not least the security of sensitive patient data.

Embedded Cloud & Healthcare

With the Embedded Cloud, Kontron has established a new cloud class that sets new standards in the healthcare environment. The Embedded Cloud is explicitly oriented to the requirements of the Medical 4.0 concept for the networked hospital. These include: low latencies, fast analyses and on-site decisions as well as a high level of security. For this purpose, the systems involved in the medical care process on the hospital premises are combined to form a local network.

Kontron developed an IoT Software Framework, SUSiEtec, which is used as the interface between medical devices and the cloud. It is the link between the devices, converts protocols, filters data and, if necessary, processes them directly on site.

This allows hospitals to take a hybrid and scalable approach to their IoT scenarios by combining the benefits of on-premise solutions with a professional cloud infrastructure. SUSiEtec is fully integrated with Kontron's Gateway, Edge, Fog, Computer and Server products, many of which are already certified for Microsoft Azure IoT Services.

Chapter 2

Edge- and Fog- Computer Interaction and Predictive Maintenance

The Embedded Cloud consists of Edge and Fog Computers/Systems:

- Edge computers are end devices such as ultrasound and ventilators or op-robots, to name just a few medical applications. Sensors and actuators are connected to these devices to collect, process and analyze data. For CTs and MRIs, the images are processed directly in these devices for immediate diagnosis.

- Fog computers include image processing workstations, for example. They perform further renderings and 3D simulations based on the pre-processed image data and store the data locally. For this purpose, all imaging devices of a department or station are connected to fog computers. Via a connection to the servers in the hospital server room, the data is stored there for a long time, anonymized and used for further evaluations.

Predictive maintenance can save lives

With the help of predictive maintenance, medical devices in the Embedded Cloud can also be maintained in advance or, if necessary, replaced promptly. This can save lives. Predictive maintenance is one of the core components of the Medical 4.0 concept. All connected devices are proactively maintained to keep downtimes as low as possible. This option allows faults to be predicted and rectified before they affect hospital operations or the condition of patients. Reliable predictive maintenance is based on reliable data that must be collected, stored and analyzed. The collected and evaluated measured values and diagnostic data are transmitted directly to the service center or the device manufacturer. Thanks to predictive maintenance, the medical device notifies the service technician before a defect occurs. This saves costs, reduces the risk of failure and thus makes the networked operation of medical equipment safer.

Predictive maintenance can save lives.

Chapter 3

How the Medical Industry Benefits from AI, Machine Learning and Deep Learning

Artificial Intelligence is an emotional subject. For some it may send the blood pressure soaring or maybe trigger another medical condition, perhaps by conjuring up images of robots or humanoid creatures taking over the world. Of course, Sci-Fi could have a loT to do with these common types of reaction: Brave New World, The Terminator, The Matrix, etc.

We're increasingly exposed to basic levels of AI in our daily lives with such things as Alexa and Siri, for example, and 'chatbots' that pop up on websites when we're doing online shopping and banking; you may like them or loathe them, but they're not scary. Some may even say they offer convenience and a sense of 'wellbeing'.

For many in the medical profession AI-enabled developments are welcome, not least due to lack of time, skills shortages, and budget constraints

Speaking of which, in the medical sciences and healthcare arena, considerable strides are being made in the application of the very latest AI techniques, notably Machine Learning, Deep Learning and Neural Networking. There was a well-publicized story from 2018 about a leading dermatologist in Germany who issued a challenge to fellow medical skin cancer experts from around the world: Could they beat his prototype AI neural network system in diagnosing images of historic potential melanoma cancer cases? On this occasion man was thrashed by machine with only 13 of the 58 dermatologists involved managing to beat the algorithm in correctly identifying more actual cases of the skin cancer rather than harmless birthmarks.

Chapter 3

How the Medical Industry Benefits from AI, Machine Learning and Deep Learning (Continued)

Deep learning algorithms can detect data patterns the human eye cannot.

AI-enabled algorithms used in medical imaging and diagnostics, for example, can achieve results in seconds rather than hours or days using the human approach. They have the potential to touch almost everything, from tomography (MRI, CT) systems to ultrasound diagnostic devices, as well as mobile devices for use in diagnostics and care.

Machine learning and deep learning analyze data sets and learn from them to make specific predictions about patient healthcare concerning an increasing array of medical conditions - from different types of cancers and dementia, to kidney and cardio-vascular disease. Deep learning has a kind of 'sixth sense' that can even make predictions from discovering data patterns that humans might otherwise overlook, providing early warning signals which may avert an illness or medical emergency such as heart or kidney failure. It can even suggest possible treatments based on tens of thousands of similar recorded medical cases. In some cases, patients will be able to receive diagnoses and medical treatment advice via mobile applications.

In the end, the more medical data become available for analysis and unification, the better AI-enabled machines and systems will become at supporting medical professionals when undertaking complex analytical tasks.

Chapter 4

Medical Systems Performance Requirements

Medical OEMs and systems developers are in growing need of more powerful platforms for supporting their real-time and graphics-intensive AI medical imaging solutions.

Machine learning and deep learning magnify medical systems performance requirements

Servers must be equipped with the latest multicore CPUs for enabling the massive parallel processing performance now required in medical imaging and AI-supported diagnostics. High speed GPU performance is naturally of major importance, too. Deep learning algorithms accelerated on industry leading GPUs can reduce neural network system learning time from weeks to hours.

Responding to the compute challenges and massive potential of AI in healthcare, Kontron has developed an extremely powerful rackmount server within its KISS Rackmount Server product line, the KISS 4U V3 SKX. Dual Intel® Xeon® SP series processors allow real-time compute-intensive processes for analyzing large amounts of data. Up to three double-width NVIDIA GPU cards ensure extremely high graphics performance, and for extended storage, up to eight 2.5" storage trays can be installed.

Like the company's other KISS server platforms, this powerful KISS 4U rackmount server is based on industry standard components for enabling ease of configuration and ease of maintenance. The flexible, modular design also allows easy adaptation to medical OEM customer-specific requirements. Crucially, its reliability means it can be used for 24/7 operation at consistently low noise levels (<= 35dBA), qualifying it for operation in noise-sensitive areas in close proximity to people. In addition, it is designed for harsh environments, suitable for use at high temperatures and in applications where it will be subject to significant mechanical stress. Long term availability and high security are also guaranteed.

Chapter 5

A Robot Arm that Understands Surgeons

A robotic arm that reacts directly to the voice commands of the surgeon and automatically steers in the required direction during minimally invasive procedures - what only existed as an idea in visionary minds a few years ago is now becoming a living reality in more and more hospitals. This new reality began with the presentation of the first voice-controlled robotic arms, including the SOLOASSIST II robotic arm from Germany based AKTORmed GmbH.

Robot arm voice control requires reliable, high-performance technology

The SOLOASSIST II facilitates surgical work with endoscopes enormously, as it can be guided flexibly/manually or fixed in a specific position as required. In the fixed position, it delivers a maximum of tremor-free, steady image and is thus clearly superior to the human hand. The disadvantages of endoscopic camera guidance by hand have been exacerbated by the technological developments of recent years. Today's high-resolution cameras produce images in 4K or even 8K quality and 3D. For many corresponding applications, however, humans lack the steady hand and even the slightest trembling movements are amplified in the enlarged reproduction on high-resolution screens to such

an extent that precise work is made even more difficult. In addition to that, human communication problems, e.g. when it is not quite clear between a surgeon and his camera-guiding colleague how far or in which direction the camera should be moved, complicate safe and efficient work. In some cases, a joystick- or voice-controlled robotic arm can completely eliminate the need for a second doctor to operate the endoscope. This makes for a crucial advantage considering the chronic lack of doctors in many hospitals.

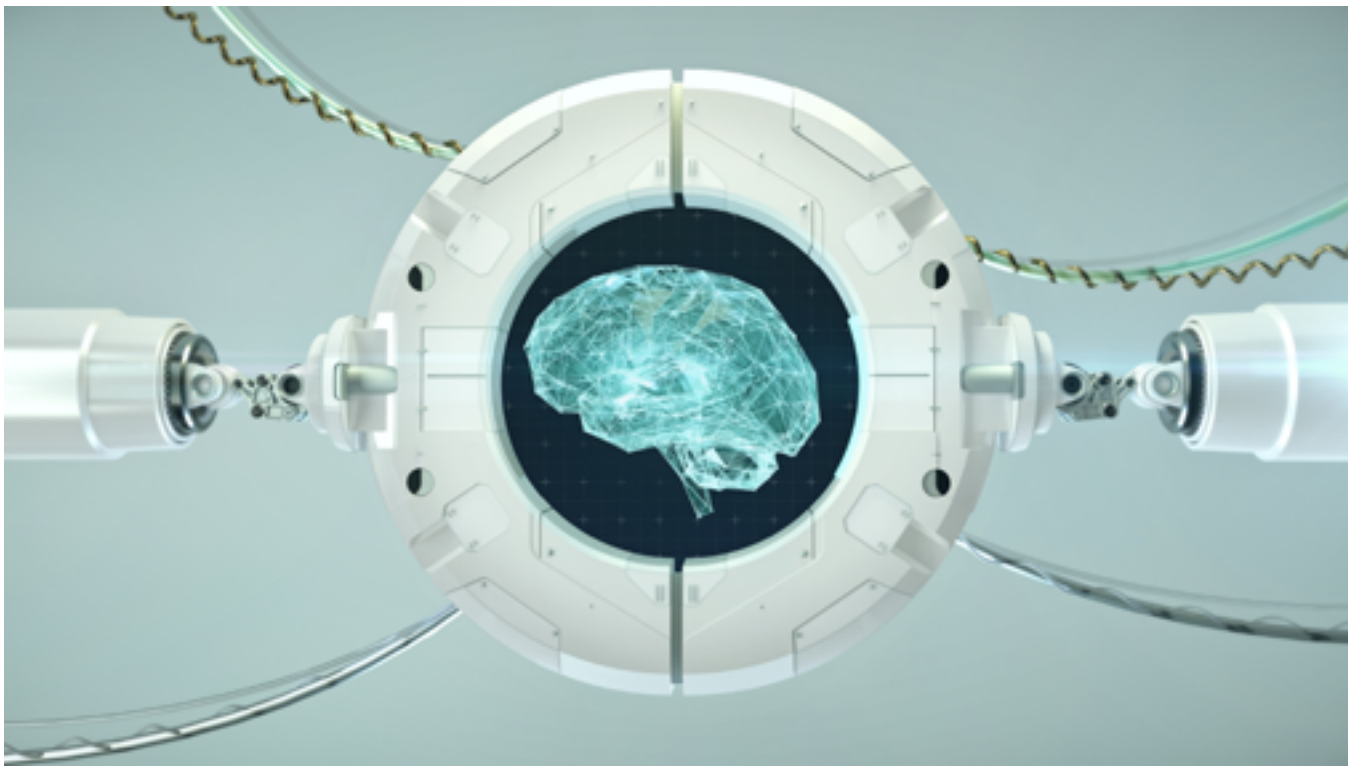
The SOLOASSIST SIIVoice voice control system is based on the leading industry standard for speech recognition. Using an intuitive instruction set, it enables smooth and uncomplicated control over the operator's field of vision. In contrast to joystick control, speech recognition and the corresponding processing requires significantly more computing

Chapter 5

A Robot Arm that Understands Surgeons (Continued)

and storage power. The developers at AKTORmed have chosen a Kontron industrial computer motherboard for the development of their SOLOASSIST II. One of many reasons for their decision: Kontron's industrial boards are designed for long-term availability and thus qualify for long innovation cycles and years of procurement projects, as is common in the medical industry.Approvals for medical devices are also generally complex, lengthy and different in every country. By selecting a motherboard from Kontron, AKTORmed has already had access to many necessary certifications such as CE, confirmations and tests for electromagnetic compatibility (EMC), confirmations for electrical safety and radio-specific requirements of the US Federal Communications Commission (FCC).

The Mini-ITX motherboard with Intel Atom® E3800 series processor has sufficient memory and numerous interfaces required in the industry. A bootable flash memory is available for the operating system, application data is stored via the SSD storage. The system is supplemented by a main memory, fan and SSD memory.



Chapter 6

Failover Guarantees Patient Safety

The voice controlled robot arm SOLOASSIST II is already deployed in numerous hospitals in Germany and in clinics around the world. The safety and reliability of the medical technology used is essential in everyday hospital life; even one functionally impaired component could have fatal consequences for the patient.

The complete software for the voice control of the SOLOASSIST II runs smoothly under Windows 7 Embedded. After three years in clinical use, AKTORmed has not recorded a single failure of a Kontron motherboard; for additional safety, the robotic arm is protected against uncontrolled movements by algorithms. The risk of injury to the patient is thus reduced to an absolute minimum.

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The additional integration of artificial intelligence could further increase safety for the patient, e.g. if the endoscope is able to find an organ on its own and position itself. It would also be conceivable that machine learning could be used to store certain surgical procedures and that the robotic arm would be able to reposition the endoscope completely independently for future operations.

Chapter 7

Where Kontron Fits into the Healthcare Digitalization Value Chain

The healthcare market is transforming rapidly, driven by the Internet of Things and its focus on connectivity, security, scalability and sustainability. Applications range from IoT end devices to infrastructure systems, moving well beyond just data collection and now enabling insight for smart, practical applications that add value to patient care by providing real-time data and also reduce the cost of care.

Kontron is helping major medical equipment OEMs to develop equipment that is simple to operate, costs less and enables connected healthcare using IoT.

As a trusted and experienced OEM partner, Kontron understands the certification process for many medical applications and knows how to design products to fulfill these needs. Kontron's board level, module, and system products are used extensively throughout the medical industry for enabling diagnostics, therapy, patient monitoring, home healthcare as well as clinical IT.

Kontron's many years of experience in medical technology and ISO 13485 certified production sites in Austria, Switzerland, and the USA enable the company to accompany a product from design to series production, and thus allow for:

- a realistic budgeting of the costs
- smooth testing and certification procedures
- component traceability
- excellent quality control
- flexible production capacities
- a timely and reliable market launch
- global logistics and long-term availability

Kontron is a flexible supplier and provides both system integration of modules and motherboards into custom solutions as well as full custom products.

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Advantages of Outsourcing in the Medical Industry

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