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ASUS IoT PE3000G: The Backbone for Surgical Robot Control and Navigation Systems in Smart Healthcare

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Applying Edge-based AI in the healthcare space has opened up a whole new domain known as "smart healthcare," and it is rapidly becoming a key technology for improving the quality and efficiency of patient care, while enhancing the safety features of the medical facilities. And in some cases, the Edge AI systems are saving lines. For example, during surgery, an Edge AI computer can process surgical images in real time, far faster than can be done by a human, providing key information and visual assistance to the surgeon. This can help the doctor make more accurate decisions during complex surgical operations, thereby improving the success rate of surgery, reducing the operation time, and reducing the patients' risks.

While improving the quality and efficiency of medical services, an Edge AI computer can also reduce medical costs by processing patient data locally, enabling real-time analysis without relying on a cloud infrastructure. In addition to lowering data transmission costs, it improves response time and enhances privacy. And by automating routine tasks, it cuts administrative overhead and optimizes resource allocation.

When looking specifically at how Edge AI can be used in smart healthcare, the following areas are either currently in use or are close to implementation:

- **Augmented reality (AR) surgical navigation**: Edge AI surgical navigation systems can convert patients' medical images (such as CT and MRI scans) into 3D models in real time and overlay them on the patient's actual body through AR technology. This gives the doctor an intuitive surgical field of view, allowing him to accurately locate organs and lesions during surgery and optimize the location and size of incisions, thereby reducing damage to surrounding healthy tissues.

- **Machine vision and image analysis**: During surgery, an Edge AI computer can instantly analyze images from endoscopes, ultrasound, or other medical imaging devices. Using deep learning models, it can identify and track the location of surgical tools, and map and monitor key anatomical landmarks, helping doctors avoid important structures such as blood vessels and nerves, reducing surgical risks.

- **Real-time decision support**: Edge AI systems can help in the decision-making process using data obtained during surgery. For example, in tumor resection surgery, AI models can help doctors distinguish between tumors and normal tissue, ensuring that the tumor is completely removed while retaining as much healthy tissue as possible.

- **Robotic-assisted surgery**: The Edge AI computer can provide fine control and greater dexterity during robotic-assisted surgery. It can process large amounts of sensor data in real time, allowing surgical robots to operate with precision beyond that of a human, increasing the safety of the surgery.
- **Training and simulation**: With the help of Edge AI, doctors can train for surgeries in virtual environments that simulate real surgeries. AI models can analyze the doctors' operating techniques and provide feedback and suggestions to improve surgical skills and prepare doctors to face the challenges posed in actual operations.

The Challenge: Precision and Performance in the OR

The limitations of human surgeons, such as fatigue and potential for error, can be mitigated by the adoption of surgical robots. These robots offer increased precision, repeatability, and the ability to train AI models for even greater accuracy. Furthermore, advanced technologies like 3D imaging and high-resolution cameras provide surgeons with enhanced visual aids, optimizing surgical outcomes.

Specifically, the robots address:

- Increasing complexity of surgical procedures: Modern surgeries demand greater precision, real-time insights, and reduced invasiveness.
- Limitations of traditional systems: Cloud-based solutions introduce latency, bandwidth constraints, and potential privacy concerns, hindering real-time decision-making.
- Critical need for reliability: Surgical environments require robust, dependable systems that can withstand demanding conditions.

How Does It Work?

In practice, the Edge AI computer combines the performance and features of Edge computing and AI deployment, with the advantages of immediacy, low latency, privacy protection, and reduced network bandwidth. It can process, analyze, and execute machine learning model inferences at the Edge to achieve real-time data analysis and intelligent decision-making, rather than sending data to the cloud for processing, reducing reliance on centralized data centers.

ASUS IoT next-gen Edge AI computers can operate in wide temperature ranges. They can handle various voltage levels, and are designed with multiple IOs, Mobile PCI Express modules (MXM), external heat sinks for optimized air flow and heat dissipation, and reduced openings.

Like their rugged industrial computer counterparts, the Edge AI computer that's destined for smart healthcare provides reliable, stable, and continuous computing support. It is designed to withstand extreme conditions such as high and low temperatures, high humidity, vibration, dust, and moisture. The goal is to provide safe and secure 24/7/365 long-term operation, with the flexibility required for future expansion and upgrades. In addition, the highest levels of data security and confidentiality are required.

The Solution: PE3000G Empowers Surgical Innovation from Data to Decisions

One Edge AI computer that's up to the task of handling smart healthcare is the ASUS IoT PE3000G series, as it accelerates AI inferencing, and provides high-performance computing and image processing. Powered by up to a 12th Gen Intel® Core™ i7 processor and supporting Intel® Arc™ A-series GPU, the fanless, rugged system is specifically designed for computer-vision applications.

The PE3000G series offers three 2.5 GbE and one GbE ports with optional PoE+. The total power budget ranges up to 100 W for connected medical devices or sensors. Furthermore, with optional MXM GPUs, the PE3000G series can drive up eight medical display outputs.

Meeting industrial standard for shock and vibration, the PE3000G series is engineered to withstand any calamities thrown its way in the smart healthcare environment. Its dual-sided heatsink design ensures that the heat generated from internal components is effectively dissipated, maintaining operating stability, even in harsh conditions. The patented mechanical design, improves the structure for rock-solid stability, solves mechanical tolerance, and provides an optimized thermal solution.

The PE3000G series has been designed to accept a wide range of power inputs, from 8 to 48 Vdc, and offers a wide range of operating temperatures, from -20°C to +60°C, with a 50-W MXM.

The core of the system is the powerful computing and rugged design of the PE3000G, as described here. It supports AI algorithms to analyze medical imaging data, generate precise surgical plans, and guide the robot arm in real time during surgery. The surgical system, which combines advanced AI technology with a robotic arm, is designed to improve the precision, safety and efficiency of surgery.

Here's how the PE3000G Edge AI computer can be deployed:

- **Preoperative planning**: Before surgery, the PE3000G will gather data from the patient's CT, MRI, and other medical tests, and combine it with AI models for in-depth analysis to identify the surgical target area and surrounding important anatomical structures. A detailed surgical plan is then generated based on this information, including the optimal entry route and operating strategy.
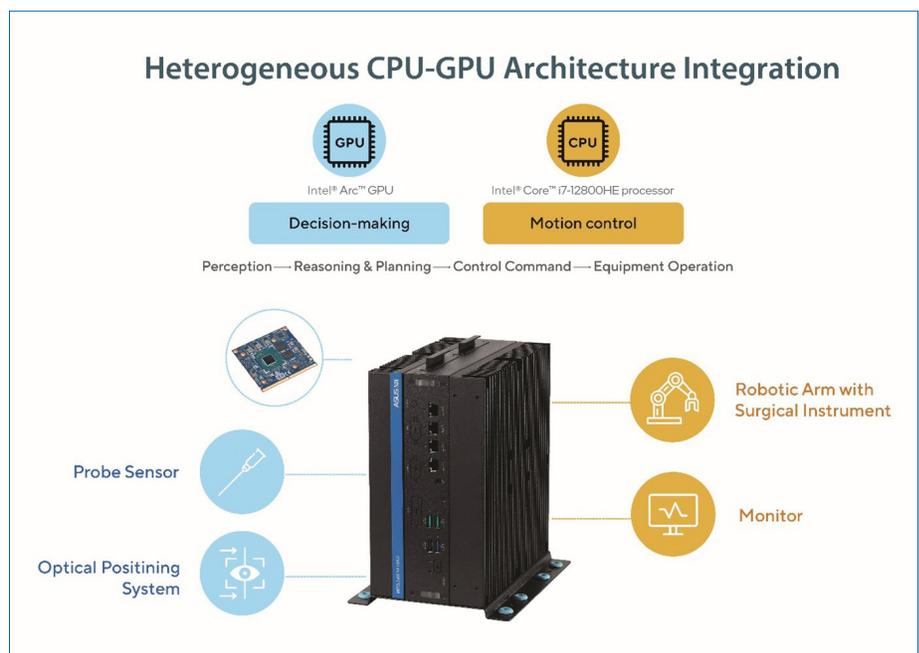
- **Real-time navigation and monitoring**: During the surgical procedure, PE3000G will process the data transmitted from the surgical site in real time, including video images, position information of the robot arm, etc. The system uses this data to ensure that the surgery is carried out in accordance with the pre-established plan, while also monitoring the surgical process to prevent deviation from the planned path or damage to important structures.

- **Precise robot arm operation**: At the heart of an AI robotic-assisted surgery system are one or more highly sophisticated robotic arms that perform operations that can be difficult for human hands to achieve. With the assistance of PE3000G, the robot arm can accurately move to the designated position and perform operations such as cutting and suturing, greatly improving the accuracy and safety of the surgery.

- **Reduce surgical trauma and recovery tim**e: Because AI robot-assisted surgery can perform very delicate and precise operations, it can reduce trauma to the patient's body, and shorten the patient's recovery time compared to traditional surgery.

- **Improve surgical efficiency and outcomes**: AI robot-assisted surgical navigation can provide more precise surgical operations, reduce uncertainty and risks, and thus improve surgical success rates.

The bottom line is that PE3000G series is a powerful Edge AI computer that accelerates local data analysis, speeds response times, decreases latency, and realizes real-time AI inference, all the attributes needed for smart healthcare and medical image processing applications. ASUS IoT can provide superior product AI computing performance and design quality, as well as world-class after-sales service and guaranteed long-term availability.

Transforming Surgical Practice: Better Outcomes, Faster Recovery

ASUS IoT is committed to serving medical specialty customers and empowering the development of the smart medical/healthcare industry with technological innovation. Based on high-end core technologies such as data algorithms, AI, and precision control, ASUS IoT successfully cooperated with its medical customer to develop Edge AI robot-assisted surgical navigation; strategically deployed solutions across five major surgical robot tracks including orthopedics, laparoscopy, percutaneous puncture, natural cavity, and medical imaging equipment; and deeply cultivated diversified departments and surgical procedures. The resulting surgical robot product line has covered orthopedics, general surgery, gynecology, urology, and other departments.

In general, AI robot-assisted surgical navigation is a major breakthrough in the development of medical technology. It can not only improve the accuracy and safety of surgery, but also improve the patient's surgical experience and recovery process. It is regarded as the development direction of future surgical technology.

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