APPLICATION NOTE

Leveraging Portwell's NURO-823E GPU AI Workstation with NVIDIA RTX™ GPU Cards for Robotic Surgery Applications

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Introduction

In the dynamic landscape of medical robotics, precision, speed, and computational power are pivotal. Robotic surgery demands real-time data processing, advanced imaging, and AI-driven decision-making. Portwell's NURO-823E GPU AI Workstation, integrated with NVIDIA RTX™ GPU cards, emerges as a game-changer, empowering surgeons and revolutionizing patient care.

The Portwell NURO-823E: A Powerhouse for Robotic Surgery

The NURO-823E, powered by 14th/13th/12th Generation Intel® Core™ processors, is purpose-built for high-performance computing. Its robust features include:

- **GPU Support**: Dual PCIe Gen 5 x16 slots for NVIDIA RTX GPU cards, enabling accelerated AI inference and image processing.
- **Memory**: Up to 128GB DDR5 4400 MT/s U-DIMM, ensuring seamless multitasking and data handling.
- **Storage**: M.2 NVMe SSD and optional SATA III drive for rapid data access.
- **Connectivity**: Multiple USB 3.2 ports and dual 2.5GbE RJ45 ports for seamless integration with surgical instruments and peripherals.
- **Power**: A 1000W ATX PSU to fuel the most demanding workloads.

NVIDIA RTX GPU Cards: Fueling AI and Imaging

The integration of NVIDIA RTX GPU cards takes the NURO-823E to new heights:

1. **Real-Time AI Inference**: NVIDIA RTX GPUs excel in AI inference tasks. Surgeons benefit from instant analysis of medical images, pathology slides, and sensor data. AI algorithms detect anomalies, assist in decision-making, and predict outcomes.
2. **Advanced Imaging**: RTX GPUs enhance imaging quality. High-resolution 3D reconstructions, precise depth perception, and augmented reality overlays become accessible. Surgeons visualize intricate anatomical structures with unprecedented clarity.
3. **Ray Tracing for Visualization**: RTX GPUs supports real-time ray tracing technology for realistic visualization. Surgical planning, preoperative simulations, and intraoperative guidance benefit from photorealistic rendering.

Accelerating Training and Simulation

The NURO-823E, coupled with RTX GPUs, transforms surgical training:

- **Virtual Reality Simulations**: Trainee surgeons immerse themselves in virtual operating rooms. Realistic haptic feedback, tissue interactions, and instrument handling refine skills without risk to patients.
- **AI-Driven Skill Assessment**: RTX GPUs analyze trainees' performance. Metrics such as instrument path accuracy, tissue handling, and suturing proficiency guide personalized training paths.

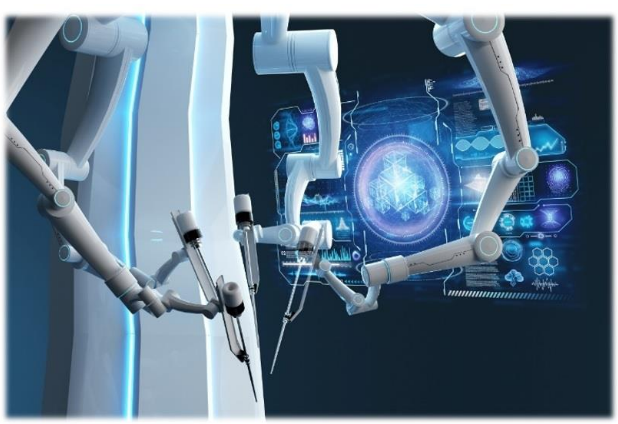
Ensuring Data Security and Compliance

Healthcare demands stringent security:

- **Secure Boot**: The NURO-823E boots securely, preventing unauthorized access.
- **Hardware-Based Encryption**: RTX GPUs include features like AES encryption and decryption capabilities, protecting patient data during transmission and storage.

Use Case: AI-Enhanced Surgical Navigation in Robotic Spine Surgery

Imagine a minimally invasive spine surgery. The surgeon, aided by the NURO-823E and RTX GPUs, visualizes the patient's spinal anatomy in 3D. AI algorithms identify critical structures, optimize instrument paths, and predict potential complications. Real-time feedback guides precise incisions and implant placement. The patient experiences faster recovery and reduced postoperative pain.



Challenges in Traditional Spine Surgery

Traditional spine surgery relies on preoperative imaging (such as MRI or CT scans) and intraoperative fluoroscopy for navigation. However, these methods have limitations:

- **Accuracy**: Manual interpretation of images can lead to errors.
- **Radiation Exposure**: Repeated fluoroscopy exposes patients and surgical staff to radiation.
- **Real-Time Guidance**: Surgeons need real-time guidance during complex procedures.

Solution Driven by the NURO-823E GPU AI Workstation

- **Image Segmentation**:
  - The NURO-823E processes preoperative MRI or CT scans using AI algorithms.
  - It segments relevant anatomical structures (vertebrae, discs, nerves) for precise surgical planning.
- **Intraoperative Navigation**:
  - During surgery, the NURO-823E fuses preoperative images with real-time fluoroscopy.
  - Surgeons receive augmented reality overlays, highlighting critical structures and pathways.
- **AI-Driven Alerts**:
  - The NURO-823E workstation continuously monitors surgical progress.
  - If it deviates from the planned trajectory or encounters unexpected obstacles, the workstation activates alerts to the surgeon.

Enhanced Precision, Safety and Efficiency Benefiting both Patients and Surgeons

1. **Precision**:
   - AI-enhanced navigation significantly improves accuracy during pedicle screw placement and spinal fusion procedures. By integrating real-time imaging data, the system guides surgeons to precisely position screws within the vertebrae. This precision minimizes the risk of complications, such as nerve damage or vascular injury, and ensures optimal fusion outcomes.
   - Surgeons can rely on AI algorithms to assess anatomical landmarks, detect abnormalities, and adjust surgical plans dynamically. The result is more consistent and reliable screw placement, enhancing patient safety and long-term stability.

2. **Reduced Radiation**:
   - Traditionally, fluoroscopy (X-ray imaging) is used to verify screw placement during surgery. However, repeated fluoroscopy shots expose patients and surgical staff to ionizing radiation.
   - AI-enhanced navigation reduces the need for frequent fluoroscopy by providing real-time feedback on screw trajectory. Surgeons can visualize the planned screw path without relying solely on X-rays. As a result, patients experience less radiation exposure, and the surgical team benefits from a safer working environment.
3. **Efficiency**:
   - Real-time guidance from AI navigation streamlines surgical workflows. Surgeons receive continuous feedback on their progress, allowing them to make informed decisions without interrupting the procedure.
   - The system assists with preoperative planning, intraoperative adjustments, and postoperative assessment. Surgeons can optimize their approach based on patient-specific anatomy and pathology, leading to shorter operating times and improved overall efficiency.

Conclusion

Robotic surgery relies on high-resolution imaging, such as MRI or CT scans, for precise navigation. The NURO-823E's GPU acceleration enables real-time image processing, enhancing surgical accuracy. Furthermore, the workstation's computational power facilitates path planning algorithms, ensuring safe and efficient robotic movements during surgery. In addition, integrating data from various sensors, such as optical tracking systems and force sensors, requires robust computing capabilities. The NURO-823E handles data fusion and decision-making seamlessly.

Portwell's NURO-823E GPU AI workstation, integrated with NVIDIA RTX GPU cards, is a catalyst for innovation in robotic surgery. Surgeons gain computational muscle, AI insights, and imaging prowess. Patients receive safer, more efficient procedures. As healthcare evolves, this solution ensures safer, more efficient procedures and better patient outcomes.

Learn More

- NURO-823E Edge AI GPU Computing Workstation with 14th/13th/12th Gen Intel® Core™ i9/i7/i5/i3 Processor Featuring Dual PCIe Gen 5 GPU Cards
- NVIDIA RTX™ GPU Cards Selection Guide

About American Portwell Technology, Inc.

American Portwell Technology, Inc., a world-leading innovator in the embedded computing market, designs, manufactures and markets a complete range of PICMG computer boards, embedded computer boards and systems, rackmount systems and network communication appliances for both OEMs and ODMs. American Portwell is an ISO 9001, ISO 13485 and ISO 14001 certified company. The company is located in Fremont, California. For more information about American Portwell's extensive turnkey solutions and private-label branding service, visit https://www.portwell.com.

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