The Networked Operating Room

— by John Phillips, Pleora Technologies

Advanced video interfaces for medical imaging systems help preserve capital investments in cameras, sensors, and processing systems — while enhancing outcomes — by delivering the performance advantages of networked video. With off-the-shelf GigE Vision® and USB3 Vision™-compliant video interfaces, manufacturers can easily design systems that integrate several image sources, multiple displays, and centralized image processing, analysis, and recording equipment.

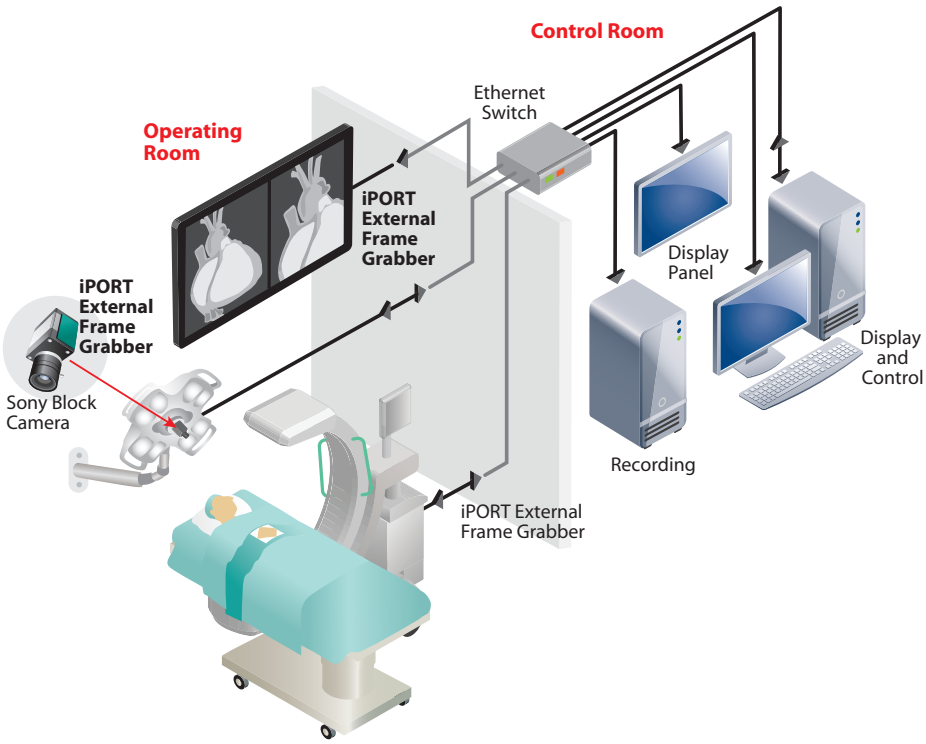

Diagram 1: Images from an x-ray detector and lamp head camera are converted to GigE Vision, processed, and multicast to various display panels in the operating room and hospital.

In a networked hospital operating room (diagram 1), GigE Vision-compliant external frame grabbers allow designers to easily upgrade existing multiscreen imaging systems into real-time networked video solutions with plug-and-play simplicity.

In this example, images from an x-ray detector are sent over an existing Camera Link or LVDS interface to an external frame grabber, where the images are converted to GigE. Similarly, an external frame grabber converts images from a Sony block camera mounted in the lamp head into a GigE Vision-compliant video stream.

The image streams are aggregated at a basic network switch, and transmitted over the Ethernet network to processing, analysis, display, and recording equipment. Video, control data, and power are transmitted over a single Ethernet cable; lowering component costs, simplifying installation and maintenance, and reducing "cable clutter" in the operating room. With Ethernet's extended reach, processing and analysis equipment can be centralized outside the sterile environment. As a result, operating costs are reduced because remotely located equipment doesn't have to be repeatedly sterilized, data can be more easily shared across multiple departments, and the risk of patient infection is reduced.

At the PC, all of the interfaces connect via standard Ethernet ports, eliminating the need for a computing platform with an available peripheral card slot. System designers can reduce system size, cost, and power consumption by using smaller form factors computing platforms, such as laptops, embedded PCs, single-board computers, and tablets.

The video processor creates a single-image stream, highlighting areas of interest including pre-op images, and overlaying vital signs information. The composite image is then multicast over the Ethernet network to various displays. In the operating room, for example, an external frame grabber converts the GigE Vision image stream to HDMI/DVI signals for viewing on a high-definition monitor used by the surgeon to track real-time patient data from different imaging devices and systems. End-users can decide "on the fly" which video streams they need to see, without any changes to cabling or software configuration.

Integrating previously isolated image sources and patient data onto a common network and presenting all information on a single dashboard can improve situational awareness for the operating room staff, contributing to improved patient safety and quality of care. The ability to multicast real-time video from different image sources to various endpoints, without reconfiguring hardware or software, may also help speed procedures and enable other opportunities to improve care. For example, real-time video can be more easily shared with other departments or remote specialists.

Advanced Medical Imaging Applications

Video interfaces based on the GigE Vision and USB3 Vision standards also speed the design and boost the performance of more advanced medical imaging applications.

In full-motion video applications, for example fluoroscopy that uses multiple moving x-ray sources to obtain real-time images of a patient, legacy umbilical interfaces are uneconomical and cumbersome. With 10 GigE interfaces, multiple image sources can be transmitted simultaneously over a switched Ethernet network to a processor for 3D image generation. For patients with limited mobility, GigE Vision delivered over an 802.11 wireless link allows portable x-ray panels to be positioned comfortably without fear of cable entanglement.

For manufacturers designing robots for hospital and home-based care applications, off-the-shelf GigE and USB 3.0 interfaces shorten time-to-market and allows R&D resources to be focused on construction, image transfer, and data analysis.

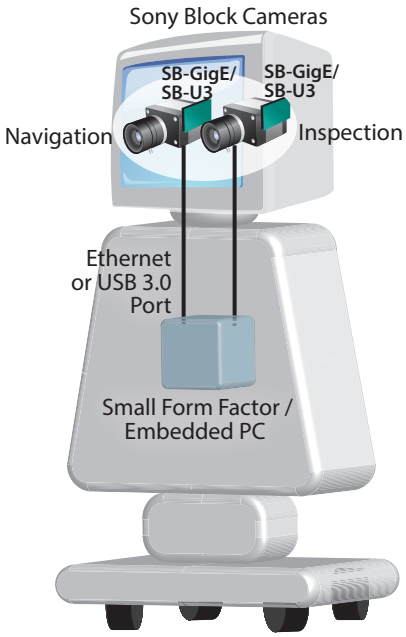

Diagram 2: Employing USB3 video interfaces in robotic applications reduce component count, costs, and system complexity while extending operating life.

In a telepresence robot (diagram 2), images from Sony block cameras used for inspection and navigation are converted to USB3 Vision-compliant video streams and transmitted over high bandwidth, flexible, lower cost USB cables directly to ports on the processing PC. By eliminating frame grabbers within the robot, designers can use smaller form factor, lower power computing platforms for real-time image processing to reduce system complexity, component count, and costs. Furthermore, by reducing weight and power consumption, the operating life of battery powered devices is also extended.

Designing or upgrading medical imaging systems with off-the-shelf GigE Vision or USB3 Vision-compliant video interfaces allows manufacturers to shorten time-to-market, reduce risk, and lower system cost and complexity, while also delivering interoperability and performance benefits to enhance the value of their solutions. ✹

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