Medical X-Ray Imaging System Improves Patient Diagnosis

For more than 40 years, Italray srl (Florence, Italy; www.italray.it) has been a manufacturer of radiological equipment for traditional and digital medical applications, and of computer-assisted systems dedicated to radiological purposes. The company's solutions—which range from simple mobile X-ray equipment to complete radiology/fluoroscopy diagnostic installations for traditional and digital radiology applications and angiography—are used in hospitals, universities, private research centers and nursing homes in Europe and other parts of the world.

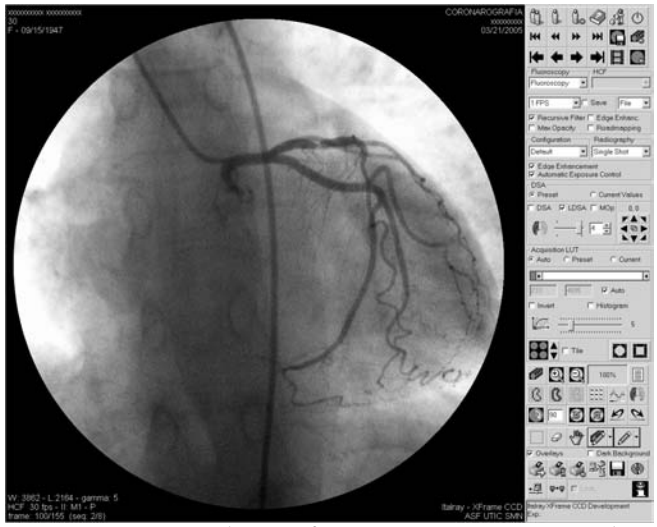
Italray medical imaging system in action in the operating room.

In recent years, Italray's laboratories have concentrated on developing and producing innovative radiological equipment at competitive prices. One of the products resulting from this research is the "X-Frame" line of digital imaging systems, which includes the new X-Frame CCD series for radiology/fluoroscopy applications. These products are the company's fifth generation of digital X-Ray products. With the help of image acquisition boards and software from DALSA (Waterloo, Ontario) X-Frame CCD systems provide the high-speed image acquisition, real-time data processing and storage capabilities and image reliability needed to address the challenges of the applications for which the systems were developed.

Imaging Challenges

Radiology and fluoroscopy applications present several challenging machine vision requirements. One is the need to acquire and process in real time huge sequences of hundreds of images so that doctors can review them on the fly, a task that is not easily accomplished by many vision systems. In Digital Subtraction Angiography (DSA), for example, the difference between the acquired image and a reference image is displayed on-screen so that doctors can trace the path of the contrast media in the vessels. As the original images are being processed, they must also be stored simultaneously to the system's hard disk.

The ability to select and apply in real time the look up tables necessary to enhance all image features relevant from the radiologist's point of view is also crucial to these applications, says Ciro Rebuffat, Software Development Manager at Italray. "In these types of radiology applications, images are typically acquired with a 12-bit CCD camera," Rebuffat explains. "A different LUT is needed, depending not only on exam typology but also on image content, to accurately convert these 12 bits to 8 bits for accurate image display."



Coronarography: Dynamic analysis of coronary arteries with a contrast media.

With these imaging needs and challenges in mind, Italray sought a machine vision solution that would provide the highest levels of performance, reliability and ease of configuration. A software development library was considered a mandatory component to make configuration easier. Having used machine vision components manufactured by several other companies over the years, Italray sought a new provider, and was immediately impressed with the performance of DALSA's boards. Since Italray started specifying DALSA products in 2001 (known then as Coreco Imaging), the company has also been very satisfied with the relationship it has established with DALSA's Italian reseller, ImageS (www.imagessrl.com) and with DALSA itself.

A high-performance solution

The X-Frame CCD digital fluoroscopic systems incorporate a 9", 12", 14" or 16" triple-field QX series image intensifier. The image intensifier produces X-ray images that are acquired by a 1024 x 1024 x 12-bit CCD camera connected to an image acquisition board by DALSA, which provides high-speed image acquisition of up to 60 frames per second (fps). The X-ray images are then sent to a vision processor (also by DALSA) for real-time processing, primarily recursive filtering and edge enhancement. "The DALSA vision engine with its independent processor is very useful because it can be dedicated to real-time processing without overloading the host system, which is used for display and storage," says Rebuffat.

After processing, the images are transferred back to the host system, where they are converted to 8-bits for display on an 18" flat-screen monitor with monochrome LCD designed specifically for medical imaging and saved in the original 12-bit format. The system provides 15 fps storage at maximum resolution and 30 fps storage at 1024 x 512 x 12, and can archive up to 15,000 images. Medical personnel can retrieve the saved images from the hard disk and manipulate them in a variety of ways, including filters, LUTs, rotations, flip and mirror.

Digital subtraction angiography:
Real-time subtraction of a reference image removes background patterns exalting the patch of the contrast media

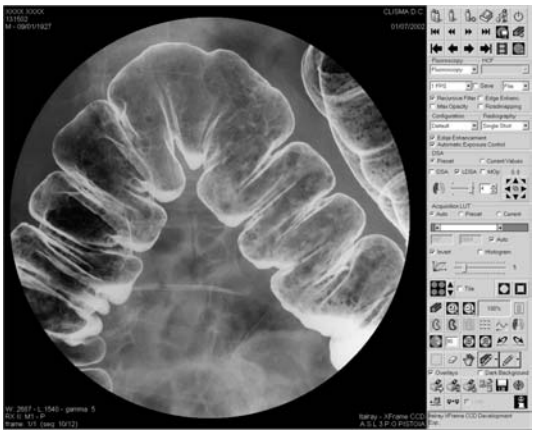
Customizing X-Frame CCD systems to meet the needs of each customer are important in this market, and Italray has found DALSA's award-winning Sapera software library for high-performance image acquisition, processing and analysis important not only for writing applications but also for customizing them. "Sapera is a very powerful tool for

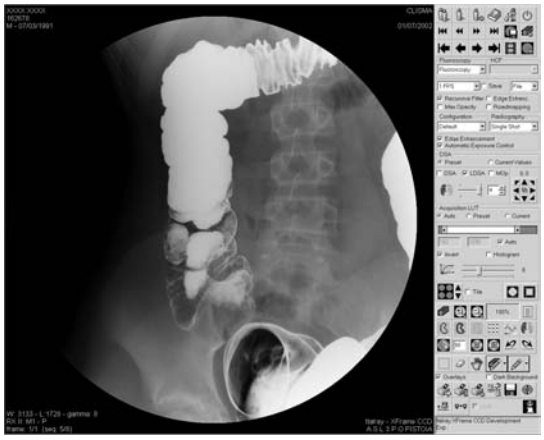
building and configuring all system features," says Rebuffat. "This library allows us to make continuous improvements to the system, and makes it easy for us to customize systems and implement new features." Optimized for Intel's MMX, SSE (Streaming SIMD Extensions) and SSE-2 instruction sets, Sapera features more than 300 functions.

Overall, says Rebuffat, "DALSA's machine vision products enable the X-Frame CCD systems to provide Italray's customers with outstanding performance in image acquisition and storage."

Looking ahead

To further their competitive edge, Italray is currently developing a new line of radiology and fluoroscopy systems based on a flat-panel digital detector, enabling radiologists an all-digital real-time system, generating high-quality images for both fluoroscopy (up to 30 images/second) and radiography applications. Since the size of the detector is larger than the biggest image intensifier (43x43 cm) contrary to traditional fluoroscopy systems, a flat panel system can easily accommodate a much larger range of exams, such as for the chest.





Barium enema images, used most commonly to check bowel health.

Also, while in traditional systems, the image intensifier/CCD camera images are circular resulting in a black band of wasted space outside of the image circle images from a dynamic flat panel detector system are rectangular in which the acquired image area all contains useful information. Dynamic flat panel detector technology offers additional benefits, including higher dynamic range (16 bits instead of 12), higher spatial resolution, a reduction in patient dose and size compactness, to name a few. ♦

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