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Design of a Digital Microscopy Imaging Platform for Pathology Studies in Pharmaceutical Research and Development

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Microscopy imaging plays a critical role in pathology. Based on our bioimaging strategies, a digital microscopy imaging platform (DMIP) was designed to take advantage of modern optics, digital imaging, the Internet and intranet, and imaging informatics [1, 2]. The development of this DMIP will enhance the practice of pathology in pharmaceutical research and development, especially for drug safety evaluation.

Figure 1 shows the pathology imaging information flow and the system architecture for the DMIP. Hardware of the DMIP includes digital pathology microscopy workstations, a multi-head digital microscopy system, high-capacity image storage servers, diagnostic-quality image display systems, and an automated digital slide imaging system, all within a high-speed imaging network. Other bioimaging modules, such as digital transmission electron microscope, automated digital slide scanner, or 3D imaging system, can be added to the platform as needed. A core component of the platform is the pathologist digital microscopy imaging workstation. Our criteria for integrating the workstation were based on the major requirements for pathology microscopy imaging, such as true color imaging, still and near-video rate image display, and a large view field with diagnostic image quality. Over 10 different digital cameras were evaluated, and based on the criteria and quantitative analysis of the digital resolution requirement for microscopy [3], the DXM-1200 (Nikon USA Inc.) camera system was selected as the current standard for the workstation. A similar review was performed for software systems, in which the ACT-1 (Nikon USA Inc.), ImagePro Plus (Media Cybernetics Inc., US), and MedMicroscopy (Trestle Corp., US), were selected for the current setup.

The DMIP is designed to be a secured imaging network with all systems linked by using our intranet and a high-speed sub-net with image storage servers. Challenges were incurred to handle the transfer, storage and management of the very large data volumes generated from ultra-high resolution and true-color imaging. Necessary protocols for image data management, such as defining/selecting appropriate image resolutions and image file formats were developed. Several image file formats were evaluated including the recently released JPEG2000 [4], which has high efficient lossless compression algorithms embedded. Gigabit Ethernet and Web-based image management technologies were also utilized to ensure high performance of the platform. Both the high-speed SAN (Storage Area Network) for linking the key systems, and the NAS (Network-Attached Storage) for future scalability of the image storage, were evaluated.

Image display and output with diagnostic-quality is vital in digital pathology imaging. For optimal correlation of the digital imaging resolution, a high-resolution true-color display system (National Display System Inc., US) was acquired, which can provide a six-million pixel (dual-monitor setup) display with diagnostic image quality. In addition to the hardware, appropriate display monitor calibration software and specially a designed calibration pattern were also used in order to improve the display quality.

By utilizing the common networking protocols and the scalability of the designed DMIP, the platform is designed to be easily expanded for other emerging digital imaging technologies, such as MR (Magnetic Resonance) microscopy and micro-PET (Positron Emission Tomography) scanning. A trial DMIP platform (Figure 2) has been established, which will provide a comprehensive integration of newly tested concepts, technologies and equipment, resulting in a high performance digital microscopy imaging platform.

References

[1] X. Ying, J. Cavallo, and B. McCullough, Digital microscopy imaging in drug discovery and development, *Microsc. Microanal. 7* (Suppl. 2) (2001) 622-623.

[2] E. Glassy, e-Pathology, L.A. Soc. of Pathologies, *http://www.lasop.org/ePathology.pdf*, 2001.

[3] X. Ying, *Digital Imaging Based Measurements and Analyses in Quantitative Biomedical Research at Cellular and Microvascular Levels*. Acta Univ. Oul., (ISBN 951-42-4245-9), Finland, 1995.

[4] D. Taubman, M. Marcellin, *JPEG2000: Image Compression Fundamentals, Standards, and Practice*, Kluwer Academic Publishers, New York, 2001.

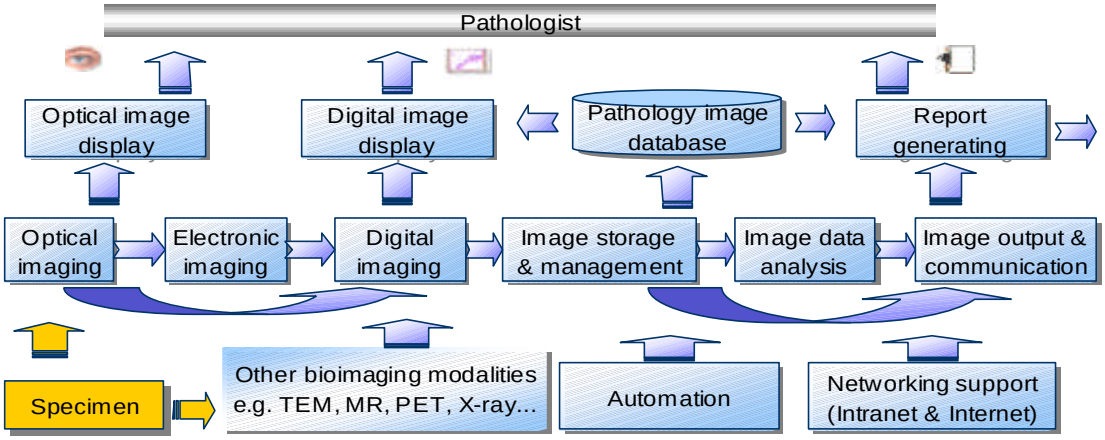

FIG. 1. Pathology imaging information flow and system architecture for the DMIP.

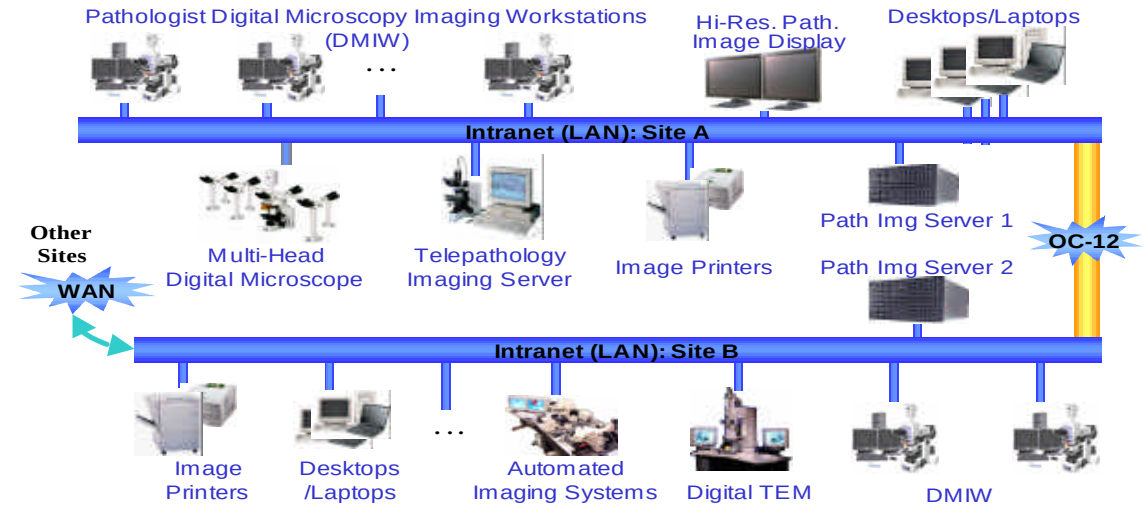

FIG. 2. Illustrating diagram of a trial DMIP.

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