



**Making Digital Imaging  
Simple**

*Development Notes:*

*Prepared for PixelINK*

**Medium Resolution  
Microscopy Camera**

Submitted by: Mike McGuire

39 Rochester Street,  
Ottawa,  
Ontario,  
K1R 7L3

Phone: (613) 276-4619  
Fax: (775) 855-4714

[mcguirem@cyberus.ca](mailto:mcguirem@cyberus.ca)

*Date:*

*Thursday, May 13, 2004*

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## 1.00 Introduction

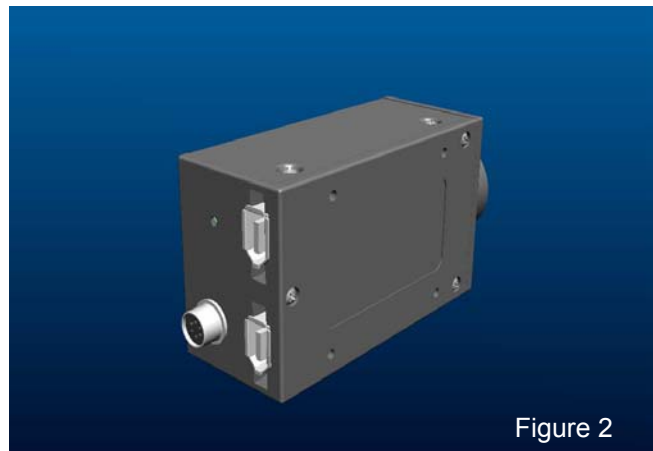
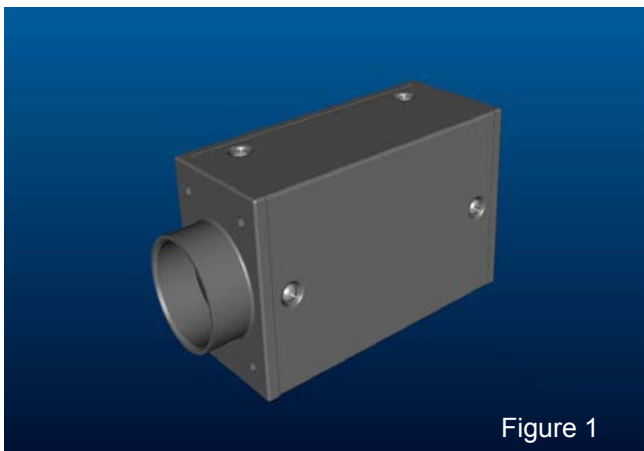
This document has been prepared to outline background information pertaining to the development of PixeLINK's new medium resolution microscopy camera. 3 different external customer visits were coordinated and directed by Mike McKay of PixeLINK. Observations from each visit are recorded separately. Some general competitive background from web searches is also included.

## 2.00 Product Description

PixeLINK cameras and camera boards are CCD camera devices used for different viewing and capture applications. Several specific scientific applications include for bright field microscopy and microscopic image documentation. Using Firewire connections, the cameras are able to transmit real-time digital video and capture still images with no image degradation. The cameras are primarily controlled via software. The cameras and modules attach to equipment such as microscopes and CCTV lenses via standard c-mounts.

### 2.10 Related Products

CMP design recently completed development of a new PixeLINK product oriented primarily at machine-vision applications and markets. (Figure 1 Through 4) Several new PCB modules have been developed and may be appropriate for the new device. Development work on the new camera will consider brand initiatives that can be used across the PixeLINK product lines, specifically for both new cameras. PixeLINK's existing product range components (PL-A662, PL-A661, PL-A641) may be used as design references for new development (Figure 5 and 6)



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2.10 Related Products Continued

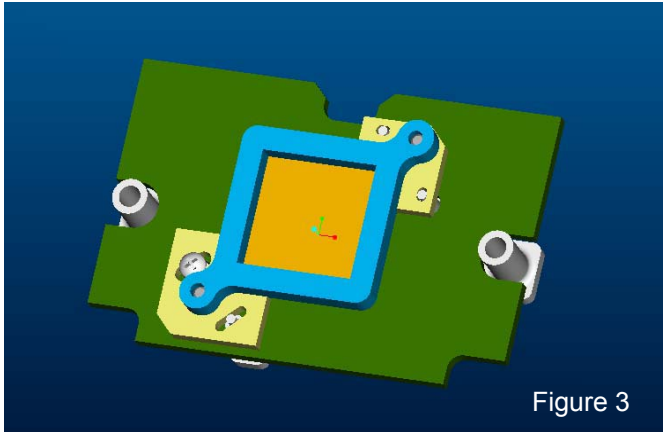


Figure 3

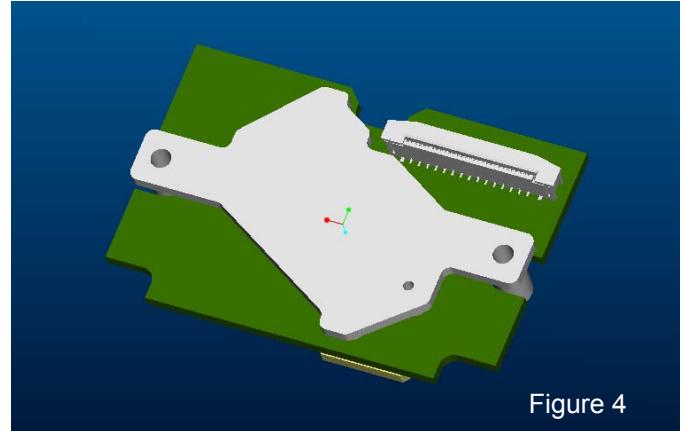


Figure 4

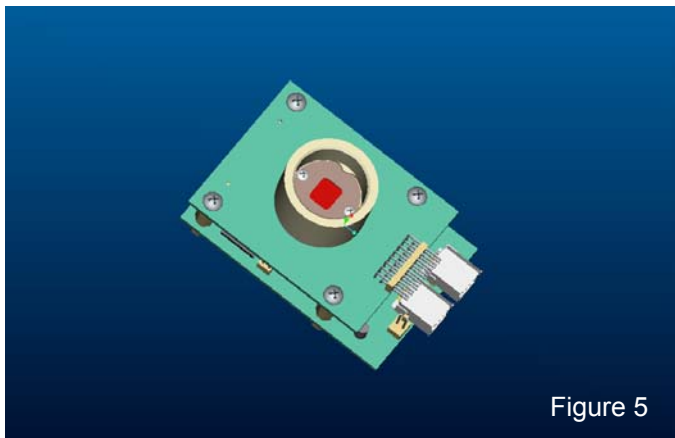


Figure 5

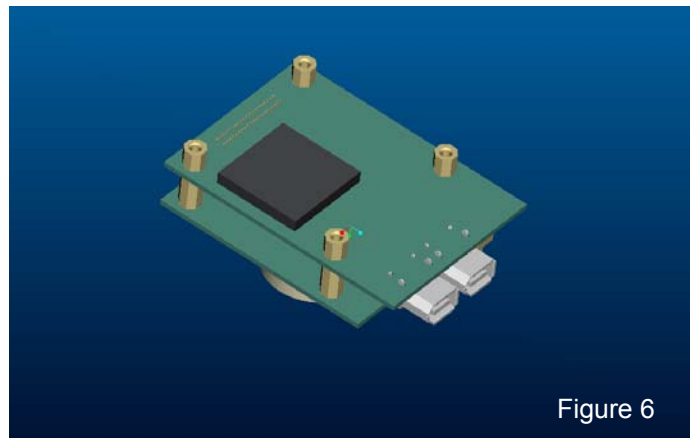


Figure 6

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### 3.00 Customer Site Visit Overview

Mike McKay of PixeLINK organized 3 customer site visits. The purpose of these visits was to gain better understanding via observation, of how existing or potential customer use the current PixeLINK or competitors products daily. Mike McKay had prepared several questions for each subject. As the leader for each visit, Mike McKay outlined the purpose of our requested visit, and initiated discussion on the occupation of the individual person, what this entailed on a day-to-day basis, their primary purpose for using digital microscopy, and the equipment they were using and how it functioned. This naturally led into more detailed discussion.

The follow sections outline via point form and images, the individual visits. Points of information are listed in the order that they were recorded; the other participants have not verified this information. Important points and conclusions are collected for each visit.

#### 3.10 Subject: Dr. Bruce Burns, Pathologist, Ottawa Civic Hospital

##### 3.11 Collected Notes

- Dr. Burns is a Pathologist; he woks in both clinical pathology (study of blood?) and anatomical pathology (study of anything removed form the body such as potentially tumorous tissue)
- His office processes 40 000 cases annually
- Each case is presented via a collection of prepared slides for evaluation by microscopy
- The Ottawa Civic Hospital has a Histology laboratory that prepares and maintains the slides as required
- Each glass slide has a label and the prepared material as shown below



- The slide label contains a case name and number and is essential to tracking results
- The slide number is tracked via a hospital data management system (HDMS) by Cerner; Dr. Burns uses a Dictaphone to record his observations and conclusions. It is not clear is the HDMS saves the recorded voice file, or if it is transposed by another person into type.
- Case slides are retained as required by law for approximately 20 years.
- Dr. Burns indicated that some more advanced HDMSs use barcodes on the slide to speed number entry and avoid errors.
- Dr. Burns indicated that Cerner, though antiquated "...does everything we need..."
- Dr. Burns has previous experience using Polaroid Digital Microscopy

- Dr. Burns' desk is arranged for microscope and Dictaphone use; it is also configured so that a second person using the dual view on the microscope can concurrently view the slide. (Figure 9)
- Dr. Burns uses digital microscopy primarily for ease of communicating, primarily for teaching sessions, conferences, and or publication in medical journals (American Journal of Surgical Pathology)
- He feels that in general, "...retaining digital images has questionable value..."
- He is currently using a Nikon Coolpix 4500 to capture images; DR. BURNS owns the Nikon.
- The Nikon Coolpix fits directly on the Leica lens
- The camera is not constantly connected to his PC (no TWAIN connection)
- He snaps images, then downloads via USB
- Dr. Burns post-processes the image using Photoshop to adjust the colour balance, brightness and contrast in order to match the digital image to what he sees in the microscope.
- He presents image primarily via PowerPoint presentations
- "...Colour Balance is essential. There are subtle variants for biopsy in the Blue-Green range..."
- "...Lamp temperature, and degradation of the microscope affects overall colour quality..."
- Dr Burns' microscope has a pointing device built into it; should there be a dedicated 'software' pointer that stays located on the digital image (when zooming) or can multiple pointers be used?



Figure 9

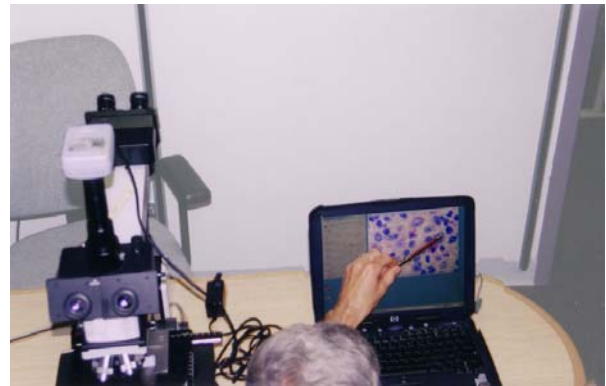


Figure 10

- Depth of Field is also a problem for the slides; that is, only part of the sample is sharp for a given focus setting; the sample has depth, and not all material can be viewed at a given focus depth.
- Dr. Burns is quite PC savvy. He knows how to operate his equipment (camera, microscope, Dictaphone, PC) and uses a variety of software (MSOffice, Explorer, File Manager, Photoshop, PowerPoint, Nikon software, Cerner); as an example, he was aware of the TWAIN interface to Photoshop that would allow direct import of images from the PixelINK camera
- Dr. Burns' office arrangement is very organized and pristine

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3.12 *Demonstration Observations (by McGuire)*

- Dr. Burns was asked to act-out and describe his process for capturing images data; his existing set-up is shown in (Figure 11)
  1. *Selects slide sample*; commented on integrity and clarity of sample
  2. *Places slide on microscope and activates device*; both hands are required to control slide position and adjust illumination.
  3. *Adjusts field and zoom*; both hands required; invites others to examine the view in secondary eyepieces
  4. *Comments on selected features*; "...you see the blocking...etc..etc.." MM – I didn't see it !
  5. *Activates Nikon; takes snap*; Nikon is attached via very long optical coupler; shakes whenever table is touched, could affect image.
  6. Downloads images to PC; this stage omitted; Dr. Burns opens some images he already has saved.
  7. *Places image in Photoshop*; adjust some basic colour balance settings



Figure 11



Figure 12

- After this process Mike McKay installed the PixeLINK camera on the microscope using his laptop to demonstrate the unit. (Figure 12)
- Note the very high c-mount adapter; this height made the unit very susceptible to minute vibrations.
- Mike McKay sets up the unit, demonstrates how to reset the white balance

- Initial image of the selected slide does not quite look correct; Dr. Burns comments on poor colour accuracy; Mike McKay makes some adjustments; image colour accuracy improves substantially
- Dr. Burns comments, "...that's exactly what I had to do to the Polaroid each time..." Mike McKay demonstrates how to save settings and describes saving particular settings for different objectives.
- Mike McKay demonstrates direct import to PowerPoint; Dr. Burns comments "...that was pretty simple..."

3.13 *Current workflow:*

**Load slide** → **Examine** → **Diagnose** → **Dictaphone output** → **Selection of desired image** → **Capture digital image** → **Save raw image** → **Manipulation in photo editor** → **Archive** → **Later use (collaboration, publication, presentation)**

3.14 *Alternate digital workflow:*

**Load slide** → **Examine** → **Manipulation in real-time** → **Capture desired digital image** → **Active archive for current case load** → **Early use (comparison, collaboration)** → **Diagnose** → **Dictaphone output** → **Archive for long-term** → **Later use (collaboration, publication, presentation)**



### 3.15 Conclusions and Opportunities

- Dr. Burns currently places low value in collecting image data; he views it as a better method of collecting and presenting data than film photography; he only captures data intermittently for interesting or unusual cases, not as a regular daily practice.
- Dr. Burns' is concerned about the time and efficiency of collecting this image data. He is also wary of archiving large data volumes, as they are not easily stored in the Cerner hospital data management system.
- Dr. Burns' workflow (selection, capture, manipulation, saving, output) seems to be a result of the way his equipment works together most easily, and his mental positioning of digital imaging as a tertiary activity. (i.e. He does not consider it particularly essential to case diagnosis)
- While Dr. Burns is very computer hardware and software literate, he did not intuitively understand some PixeLINK software options; he would most likely take time to learn via manuals and help files.
- There may be an opportunity to enhance software functionality to improve the overall product results and experience. This may be a simple matter of more graphically depicted adjustment tools (Figure 13), additional preview dialogue boxes (Figure 14), or custom, less-windows graphical interfaces (Figure 15).

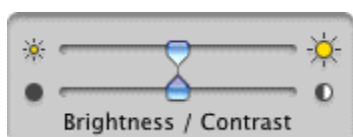


Figure 13

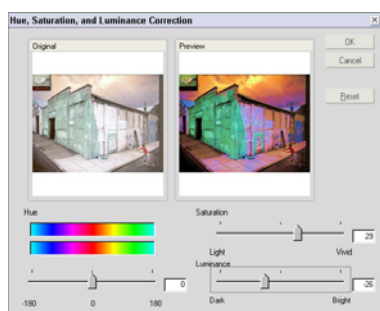


Figure 14



Figure 15

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- During set-up and review of slides, both hands are required to adjust and re-adjust the microscope. If case throughput is a primary concern, secondary activations devices such as foot pedals and accessory keypads may be necessary make snapping slides easy and to aid adjustment of images in software.
- Currently, the microscope is the focal control point and visual inspection point; doctors *TRUST* what they see
- With more reliance on digital imaging, it will be necessary to provide convenient controls and view screens in close proximity to the current microscope controls and eyepieces respectively; SONY's PCB inspection video scope incorporates an LCD Screen to improve ergonomic considerations. (Figure 16)
- Olympus' MIC-D educational video microscope (Figure 17 has very few manual controls and relies primarily on software to adjust images. (Java demo: <http://www.mic-d.com/demo/index.html>)
- Nikon's new Coolscope (Figure 18) is a completely digital solution; this completely focuses the user on the PC for all adjustments; even the microscopy adjustments are in software; this may pose a use problem for operators experienced with conventional microscope use.  
(<http://www.coolscope.com/eng/products/index.htm>)  
(<http://www.coolscope.com/eng/virtual/index.htm>)

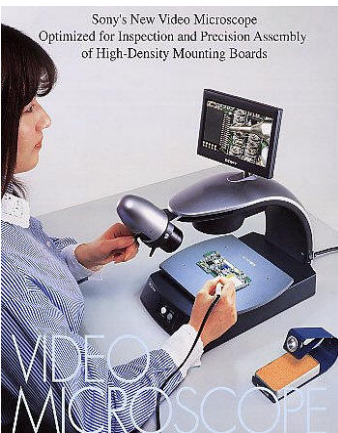


Figure 16



Figure 17



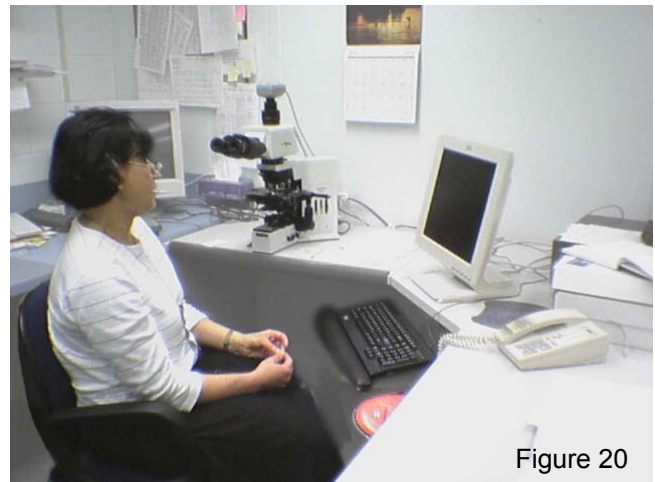
Figure 18

- Consider the workflow and how to improve or facilitate accuracy and speed. Primary improvements will most likely be in software; some physical keys that activate and adjust the software would improve product use and overall product experience.

4.10 Subject: Dr. Maha Jabi, Pathologist, Queensway Carleton Hospital

4.11 Collected Notes

- Dr. Jabi is a Pathologist; her office processes various types of biopsy samples
- Dr. Jabi often uses images for collaboration
- She uses slides prepared by the Civic Hospital's Histology lab.
- Microscope: Olympus BX50 with PixeLINK camera PL-A662 (Figure 19); this equipment was purchase by the hospital; she indicated that funding for new equipment is very tight.
- Dr Jabi purchased her own 15" LCD monitor; this was to reduce her exposure to transmitted radiation; (Figure 20)
- Her workspace seems to be primarily centered on he PC; note that the BX-50 is not a dual view microscope

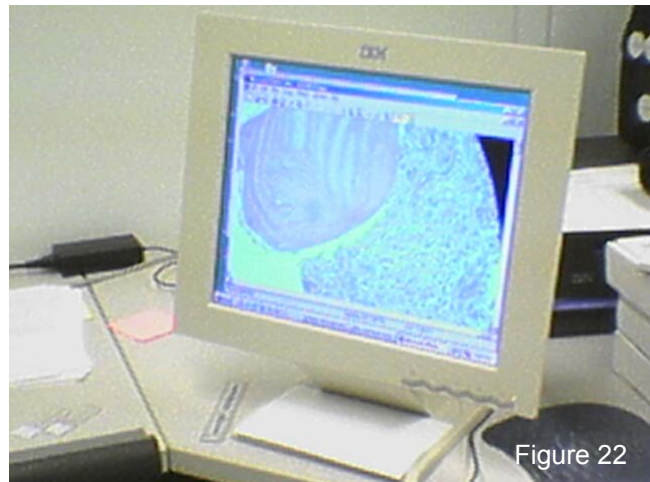


- Dr. Jabi feels that "...I am not very good with computers..."
- MM; I noted that Dr. Jabi's screen resolution was set to 800 x 600; this is quite low and reduces available image viewing; we were not able to increase resolution, as she does not have Administrative privileges on her PC.
- Dr. Jabi indicated that the hospital's MIS staff set-up both her PC, and the PixeLINK camera; she did not have the PixeLINK documentation with her.
- The PixeLINK software was not the latest release; she did not have external Web access to download the latest drivers.
- Dr. Jabi; "...I didn't read the manuals...", "...I just play around until I get what I want..." She does not have a verbose understanding of what the software image controls are doing to the image; she is very much a "try-then-reset-then-try-again" user.

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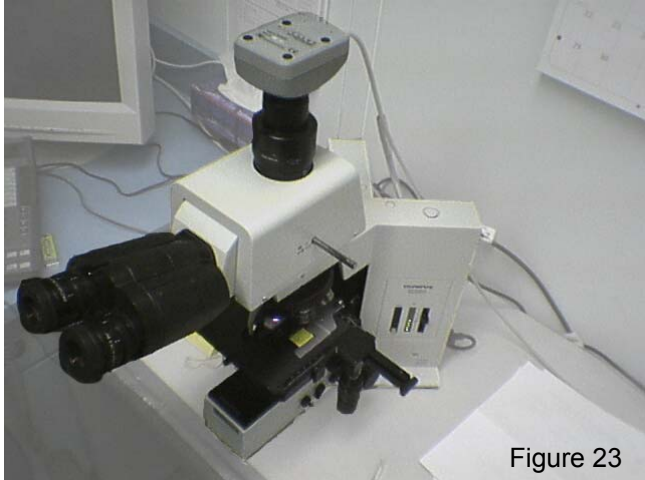
4.12 *Demonstration Observations (by McGuire)*

- When demonstrating how she uses the camera, Dr. Jabi obtained the view she wanted in the microscope, then turned to the PC to see what was on the screen; noting it was not focused, she had to adjust the microscope to focus the PixeLINK image; this is because the camera focus does not match the microscope focus (parfocality) This seems to indicate an incorrect C-mount. (Figure 21)
- Mike McKay made a few basic adjustments to the system (white balance) and vastly improved the resultant image. (Figure 22) Dr. Jabi was impressed at how much better the results were. (Less manipulation required)



- Dr. Jabi pointed out several cell features on the microscope that were not sufficiently resolved on the LCD screen; Mike McKay indicated that this is a limitation of the 1.3MP PixeLINK camera.
- Dr. Jabi "...Low power observation is often hard to focus..."
- Dr. Jabi has been using MS Picture Editor to adjust images as required; she does not seem to have any other application for picture correction. She adds labels and pointers in order to e-mail slides.
- Dr. Jabi "...I like to save pictures to show other people as my microscope is not a dual-view unit..."
- All image data is stored on the hospital network; data is moved throughout the hospital via the network; Dr. Jabi knows that at the Ottawa General, many of the doctors have laptops and can carry them around to do presentations.
- Dr. Jabi often has to publish finding and work with Black-and-White images.

- Dr. Jabi's equipment arrangement is not as pristine as Dr. Burns'
- There are cables and power bars piled around the equipment (Figure 23 and 24)

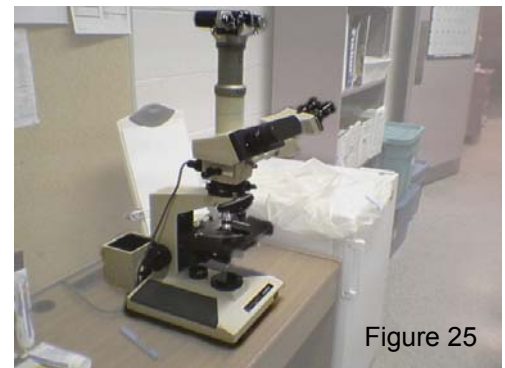


#### 4.13 Current workflow :

**Load slide** → **Examine** → **Decide of slide view to capture** → **Adjust microscope for digital image** → **Manipulation in real-time** → **Save image** → **Adjust colour balance of image** → **Early use (comparison, collaboration)** → **Diagnose** → **Dictaphone output** → **Archive for long-term** → **Later use (collaboration, publication, presentation)**

#### 4.14 Specimen and Storage Lab Notes

- After speaking with Dr. Jabi, we were taken on a tour of the other Pathology labs and offices.
- There are several different doctors and technicians using similar set-up at this hospital.
- In the biopsy preparation lab, another film based set-up is used by technicians as required; they take images primarily when requested by surgeons (Figure 25)
- Gross specimens are photographed on a large copy-stand
- They recently obtained a Nikon Coolpix 4500 for digital imaging
- They snap images and later download via USB.



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- The storage are of the facility handles access to all archived slide data; it is largely manual and has no current capacity to handle mixed-media

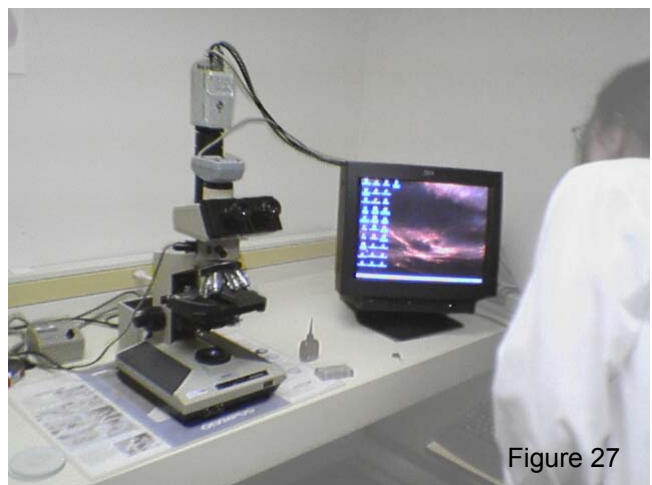
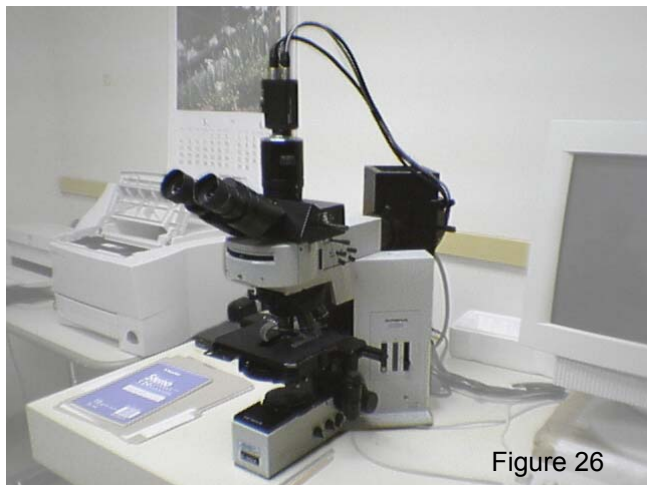
#### 4.15 *Conclusions and Opportunities*

- Dr. Jabi places value on using quick-capture digital images as a means for successful (possibly essential) collaboration
- Dr. Jabi's workspace seems more PC-centric, making it somewhat easier for her to switch her focus between microscope and PC Software
- Dr. Jabi has limited understanding of computer hardware and software; her MIS technicians handle all software and hardware set-up and configuration; *it is important to make this distinction between users.*
- Dr. Jabi seems to have good faith in the technology; she is willing to learn and sees immediate value.
- Dr. Jabi will benefit from the increased camera resolution of the new model; funding to purchase a new model will be difficult to obtain as the device may not be perceived as a necessity.

5.10 Subject: Dr. Louise Peltier, Image Capture Lab, Ottawa General Hospital

5.11 Collected Notes

- Dr. Peltier and her supervisor, Doug, handle the capture, manipulation and storage of all digital pathology for the OGH
- This includes considerable documentation work for presentation and publication
- The lab has several microscope set-ups with several different types of cameras including a B&W Sony (Figure 26), a PixelINK PL-A662, and a 3 CCD Sony colour camera (Hi-Res?) (Figure 27)



- This team seems to have the most experience using digital imaging; it is pretty much all that they do.
- They use a variety of software; Paint Shop Pro, Image Pro plus, some other slide pathology imaging tools.
- They seem to be using Paint Shop Pro to organize and retrieve files.
- They also have a variety of output devices; it is not clear how they are colour balanced
- There are multiple user within the lab; this is often a problem as different user adjust hardware and software settings; in PixelINK's case, people frequently overwrite the A B C settings and each must be reset, slowing workflow.
- Doug is a power user; he wants to be able to read-into the PixelINK software, "SDK" and other configuration settings; this may be to cross-configure different cameras.
- Doug: "...Ideally, you would have a camera software setting for each objective (10X, 100X) and you would keep the microscope illumination setting the same..."
- Major issues associated with their workflow:
  1. Repeatability; for different sample types, and camera set-ups

- 2. Colour accuracy; currently, there is always some post-processing
- 3. Speed; throughput is important

5.12 Demonstration Observations (by McGuire)

- Mike McKay took a quick look at their PixeLINK camera set-up to determine if the configuration was up to date; a firmware upgrade could-not be done due to the vintage of the unit; a software update was required but could not be completed
- Mike installed the prototype camera to demonstrate the improvements

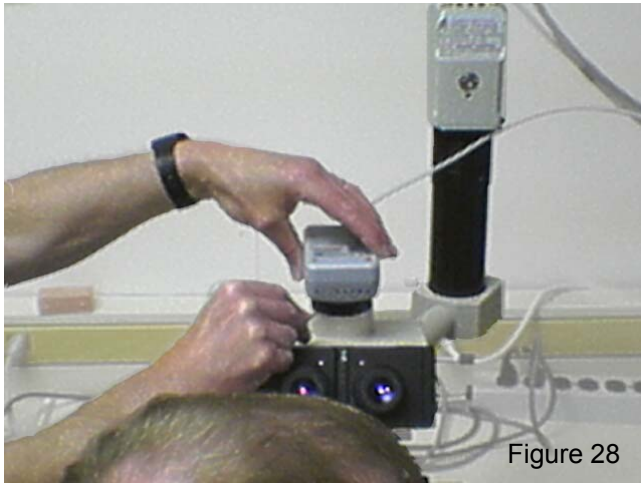


Figure 28

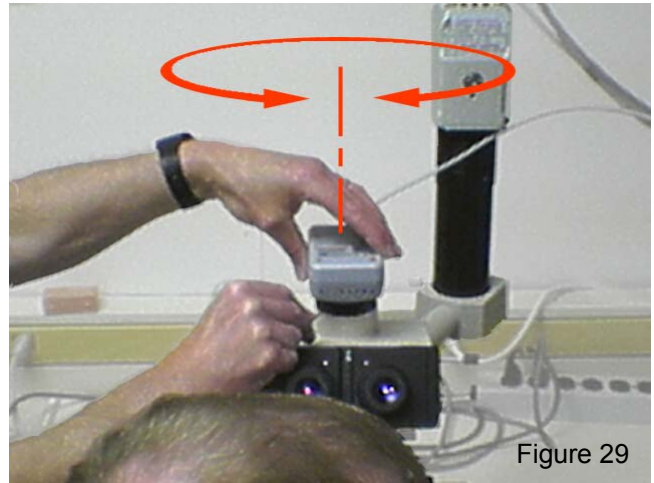


Figure 29

- After installing, the image was incorrectly placed; the camera C-mount had to be repositioned to align the camera image with the slide. (Figure 28 and 29) Is this indexing important if a filter is added?

- Louise and Doug are both very proficient with the hardware and software at their disposal.
- Both commented on the significantly improved resolution, and colour accuracy of the prototype camera

Doug: "most problems occur at low magnification"

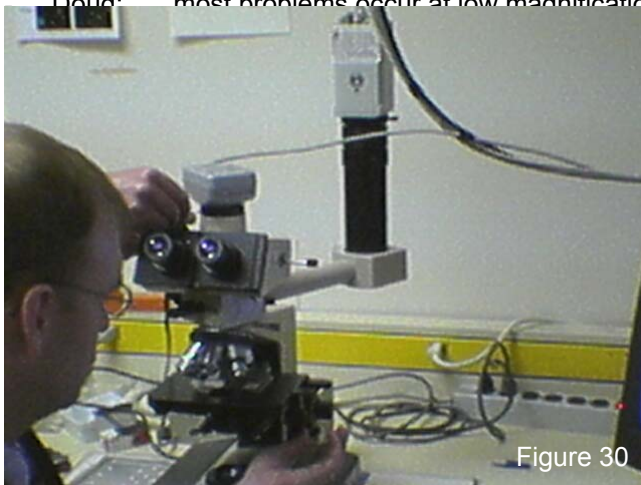


Figure 30

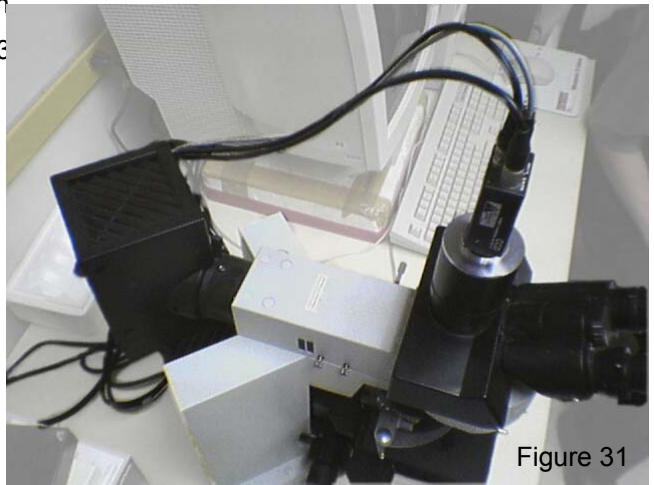


Figure 31

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5.13 Current workflow:

**Load slide** → **Examine** → **Decide of slide view to capture** → **Manipulation in real-time** → **Save image** → **Adjust colour balance of image as required** → **Archive output** → **Later use by others (collaboration, publication, presentation)**

5.14 Conclusions and Opportunities:

- Louise and Doug both seemed encouraged by the accuracy of the new camera's colour and the automatic white balance; this would probably improve throughput for their lab
- Doug, as a power user, seems to want / need more discreet software settings, and even greater flexibility in being able to repeat settings (possibly numeric entry or text-file saving); he may want to do this to start each different camera at the same baseline settings.
- Colour balancing between equipment is a potential problem similar to graphic design production; currently, there does not seem to be a method to create a colour profile that travels with the image; in Adobe Photoshop (Figure 32 and 33), there are standard colour profiles pre-configured for use that provide repeatability across platforms and devices; this may be more important as digital imaging pathology becomes more prevalent.

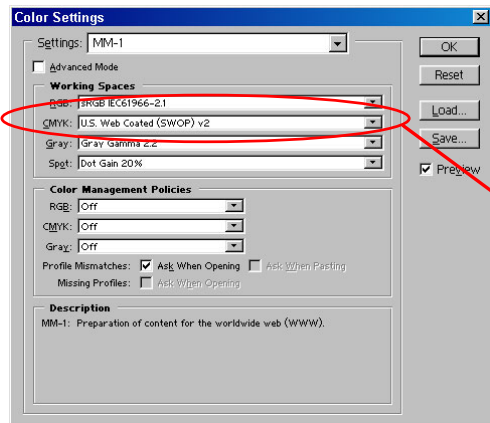


Figure 32 - Set Colour Profile inside image

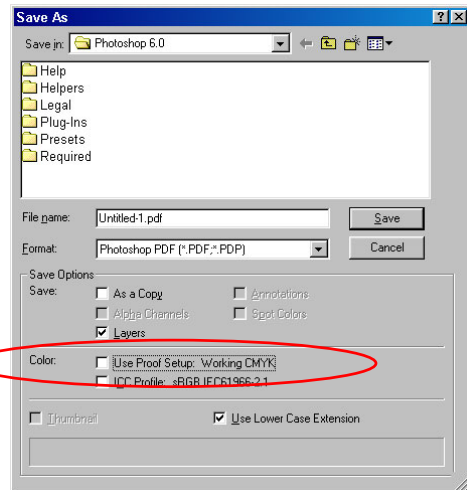


Figure 33 - Colour Profile saved with image

## 6.00 Links:

### General:

<http://micro.magnet.fsu.edu/primer/index.html>  
<http://micro.magnet.fsu.edu/primer/virtual/virtual.html>  
<http://www.pathology.pitt.edu/apiii96/author/slides/schubt2/index.htm>  
<http://www.wamb.casaccia.enea.it/gic/Micro-Software.html>

### Resellers

<http://www.imagingplanet.com/cgi-bin/imgpln/>  
<http://www.pulnix.com/>

### Software:

Nikon Coolscope Virtual Demo: *(good demo, could possibly be used to train people)*  
<http://www.coolscope.com/eng/virtual/index.htm>  
Olympus MIC-D Software Demo: *(good demo, could possibly be used to train people)*  
<http://www.mic-d.com/demo/index.html>  
Zeiss:  
<http://www.zeiss.com/us/micro/home.nsf/Contents-FrameDHTML/66061B8276F1582885256B51005698AE>  
Flash Simulation of Intel Children's Microscope: *(good demo, could possibly be used to train people)*  
<http://micro.magnet.fsu.edu/optics/intelplay/simulator/index.html>

### Hardware:

Nikon Coolscope:  
<http://www.coolscope.com/eng/products/index.htm>  
Sony Video Microscope:  
<http://www.caltextsci.com/videomicroscope.htm>  
Olympus DP-70:  
[http://www.olympusamerica.com/seg\\_section/seg\\_product.asp?p=6&sc=2&product=900](http://www.olympusamerica.com/seg_section/seg_product.asp?p=6&sc=2&product=900)  
Olympus MIC-D Educational Microscope:  
[http://www.olympusamerica.com/seg\\_section/seg\\_product.asp?p=1&sc=&product=717&fl=9](http://www.olympusamerica.com/seg_section/seg_product.asp?p=1&sc=&product=717&fl=9)  
<http://www.mic-d.com/>  
Pixera:  
<http://www.pixera.com/>  
Optronics:  
<http://www.optronics.com/products.html>  
Zeiss:  
<http://www.zeiss.com/us/micro/home.nsf/ContentsFrameDHTML/66061B8276F1582885256B51005698AE>  
JVC:  
<http://pro.jvc.com/prof/jvchome1.html>

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***Submitted by:***

***Mike McGuire***

39 Rochester Street,  
Ottawa,  
Ontario,  
K1R 7L3

Phone: (613) 276-4619  
Fax: (775) 855-4714  
mcguirem@cyberus.ca

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