Reviewer's report

Title: Enhanced virtual microscopy for collaborative education

Version: 1 Date: 2 December 2010

Reviewer: Robert Bloodgood

Reviewer's report:

This paper describes the process of implementation of Virtual Microscopy at one US medical school, New York University School of Medicine. The paper has a very good introduction to the literature on Virtual Microscopy followed by a detailed description of the software that the authors developed in order to deliver functional virtual slide files through a web interface in a medical education context.

Obviously, there already exist a number of ways to deliver Virtual Slides to students. The authors have developed an open-source Virtual Microscopy viewer based on the Google Maps engine (the first time this approach has been taken). I compared the author’s slide viewer with two other web viewers: 1. The Iowa Virtual Slidebox available on the web at: http://www.path.uiowa.edu/virtualslidebox/ and 2. The Dartmouth medical school site using the Zoomify technology: http://www.dartmouth.edu/~anatomy/Histo/index.htm and it certainly has many advantages for teaching.

All the viewers allow the student to easily move the image in the X-Y plane and to change magnification in steps. The Iowa Virtual Slidebox viewer allows the user to change brightness on a continuous slide bar and to post supplemental images (Gross or Virtual Human, for instance). The authors’ viewer has additional and rather unique features that have value added. The most interesting new feature allows any student viewer to add their own individual annotations using a numbered “pushpin marker”. An index of the annotations appears to the right of the slide image allowing one to explore the various annotations provided by different faculty and students. An “auto-refresh markers” feature allows annotation data to be synchronized across web browsers participating in a real-time collaborative lab session. This marker system can lead to “junk” or misidentified structures; interestingly, the authors have included a feature that allows users to rate markers and to even vote a marker off the image. In addition to the numbered pushpin annotation markers, there is an additional “image marker” which (albeit a little unclear to me because I could gain access to use it) allows students or faculty to embed links (Gross anatomy images, diagrams, Powerpoint slides) related to a structure on a slide. Faculty can also add links to related Virtual Slides as a pull-down menu. In truth, annotation continues to be the weak element of ALL Virtual Microscopy systems and viewers (be they web-based or not); I would have liked to see these authors, or someone else, develop some seriously user-friendly annotation tools that resemble, at least to some degree, what faculty and students can do with
Powerpoint to annotate an image. While these authors have added some very clever teaching tools, they have not really solved the problem of user friendly annotations; indeed, they do not appear to even have some of the annotation tools found in Aperio’s ImageScope (such as the ability to place a box or circle around a cell or structure in a Virtual Slide). There must be definite programming reasons why much more sophisticated annotations have not appeared in Virtual Microscopy viewers but this reviewer continues to be ever hopeful that someone will attack this problem in a serious way.

One of the nicest aspects of this project is that the authors are making their software open source and readily accessible to others and they should be congratulated for this.

The paper does not have much of an aspect of medical education research other than the fact that the authors have compared data from one summative practical exam from 2007 (pre-Virtual Microscopy) with one summative practical exam from 2009 (post implementation of Virtual Microscopy) and show no difference in student performance arguing that a switch to Virtual Microscopy does not affect academic performance in a negative manner. This has been shown in a much more rigorous manner by Scoville et al. (2007). While the authors do cite this landmark study, they should perhaps cite it again when they mention their own performance data. It sounds like New York University is continuing to use faculty staffed histology laboratories, which I think is very important and very commendable. They point out that they can now cover the same amount of material per lab in one less hour per lab than prior to using Virtual Microscopy technology.

I think the authors have made an important technical contribution to further developing the technology behind improved Virtual Microscope viewers that have features that promote the effective use of Virtual Microscopy in educational settings. For this reason, the paper certainly deserves to be published. I have no compulsory or minor essential revisions, I make one suggestion above for a citation addition.

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare that I have no competing interests.