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Experiments In Extracting Digital Slides From Video

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Introduction/ Background

While digital pathology systems are becoming more and more affordable and thus diffused, for occasional, non diagnostic acquisitions (e.g., teaching) it might not be economically viable to buy a scanner. In addition to that, it is relatively common that videos from microscope are published for teaching purposes in particular in fields related to medical imaging [1]. Recently, a research group published a series of papers related to digital slide acquisition from non-automated microscopes [2], [3]. The developed technique allows to reconstruct a digital slide starting from a video flow acquired during slide examination. The proposed method seems interesting, and stimulated us in investigating further alternatives. In fact, the proposed process very closely resembles the creation of panoramas from multiple pictures through stitching, or the simulation of medium format photography through the Brenizer method [4].

Aims

Aim of the present work is to explore techniques for extracting digital slides from microscope video recordings, possibly using already available and open source software.

Methods

We searched for panorama stitching software and found a number of packages, including a widely used open source software (Hugin) [5]. We concentrated on it and on a commercial product (AutoPano). We designed a two steps experiment:
1) For a first approach, we decided to use a screencast of a digital slide. This to reduce the possible sources of error, and also to have a gold standard to compare with.
2) At a second step, we recorded video from a microscope (Olympus Provis AX70) using a commercial camera (Sony Nex-6) on an easily replicable hardware setup (fig.1).

We devised a sequence of steps to obtain digital slides as if they were panoramas recorded in video. This included pre-processing of the video source, and selection of parameters of the software for best reconstruction

Results

The designed workflow include:
1. record a video from the microscope while browsing a case, taking care in covering the whole sample in a continuous way.
2. Transform the video in a sequence of images to feed the stitching software. This can be done with free software like ffmpeg and derivatives. It is not needed to have every frame of the video: the number is related to the speed of examination. In our experiment, 2-4 frames per second have been sufficient.
3. With Hugin (or AutoPano), open all the images and set them as if they were captured with a teleobjective with very long focal length (e.g., 1000mm). This to minimize aberrations in reconstruction.

Figure 1 shows a digital slide obtained with Hugin from digital microscope screencast; Figure 2 shows a digital

slide obtained from a real microscope. The former is much better, and this indicates a possible way for occasional scanning.

Open issues include:

- the method should be validated by comparing with a gold standard, like a digital slide of the sample;
- if the focus position changes during the video, focusing should occur and further processing could be needed for applying also focus stacking to the operations.
- While looking at a slide at higher magnifications, it is difficult to ensure to visit the whole sample during visualization. From this point of view, the realtime implementation presented in [2] allows for continuously checking what it has been acquired.
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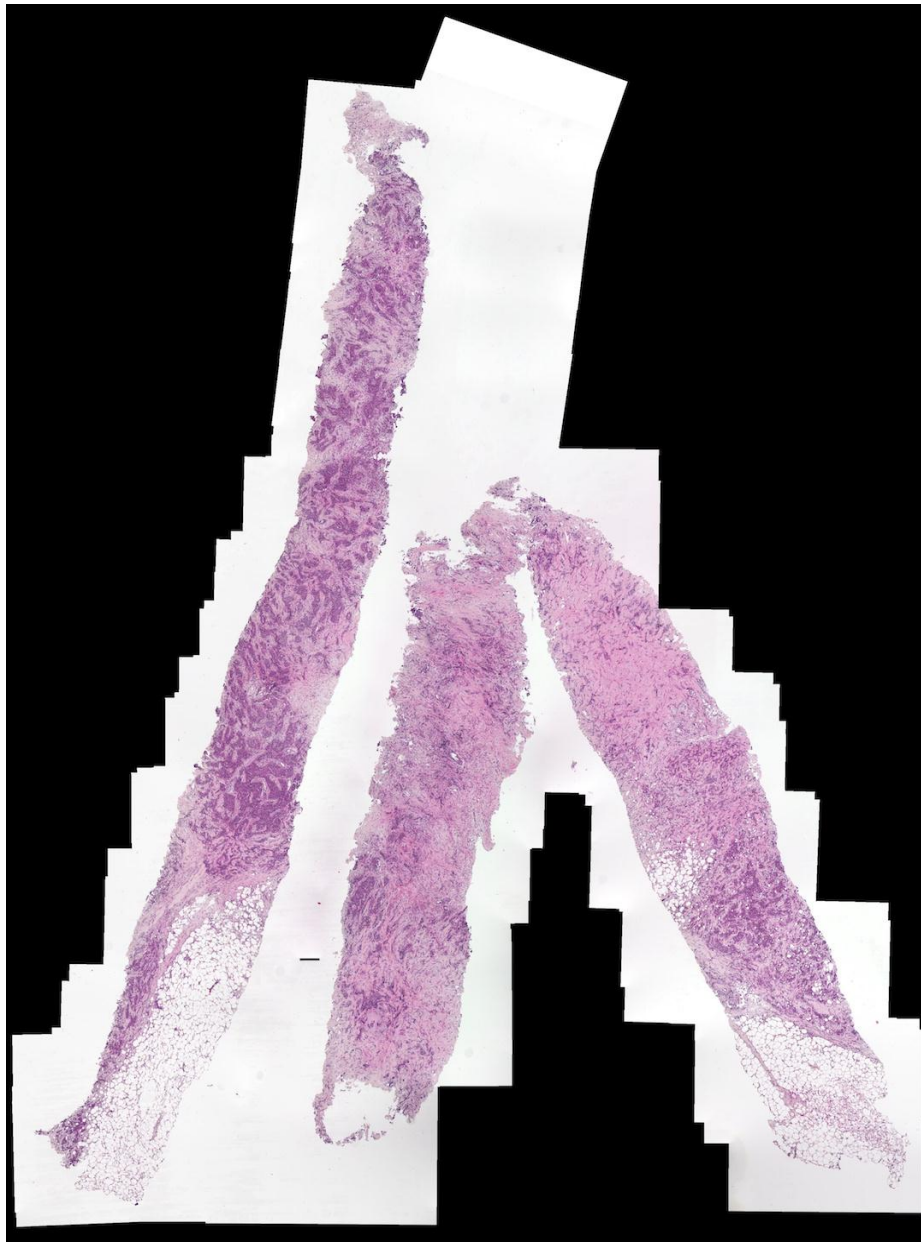
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