Progress Report 3 - 14/5/18 **Gael Humblot-Renaux**
Bsc Assignment - DMB s1570609

Looking back

Goals for this week:

- Find solutions for problems:
  - acquiring images with different exposures (limited by camera's automatic settings)
  - limitations of setup: reflection from LEDs, cables inside, filter itself?
- Show planning
- Revise research questions

Progress

Setup improvement & observations

- Tried lots of different setups eg. covering the scanner with black paper. Overall, it seems that shielding the finger from ambient light gives the best result. When using a black cover, the utility of the IR filter is very questionable
- Adjusted focal length of veins to make sure veins look as sharp as possible
- LED strips still a problem unless we use the black window which blocks any light around the finger
- Raising the finger closer to LEDs seems to reduce scattering, maybe lower LEDs in future setup?

Image acquisition

- Managed to acquire images with different exposures by using camera automatic settings via Matlab: the trick is to use low brightness and low LED illumination
- Wrote Python scripts to control LEDs and acquire images from the Raspberry Pi itself. This allows us to disable automatic camera settings and fix the exposure manually instead. Seems promising for acquiring images at different exposures & much faster than Matlab. Will continue working on an embedded implementation.
- Not all LEDs need to be on at once; only lighting half of the LEDs seems to produce decent results. Need to adjust this automatically based on person's finger
- Resulting images are still pretty mediocre, difficult to reproduce results from Sjoerd's paper. Low contrast between veins and surrounding tissue.

Combining multiple images:

Tried pixel-wise HDR reconstruction. First attempt consists of simply using a scalar value per image indicating the global exposure level (computed from gray value). However, this is far from optimal due to different levels of thickness of the finger in different areas & due to the assumption that exposure and mean gray value are directly correlated. Second attempt consists of using a matrix with local exposure values (moving mean) for weighting pixels. This results in a more homogeneous background illumination in the reconstructed image. Next step: find better metric for evaluating pixel quality & weighting different pixels in resulting image.

Research questions

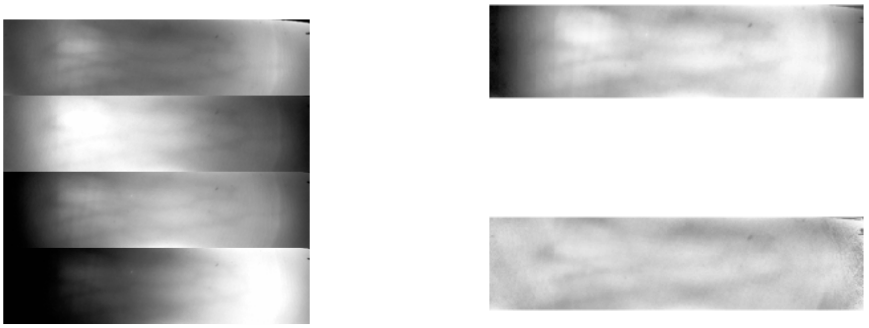
How can High Dynamic Range imaging be implemented to improve the quality of finger vein images?

- How can the current setup be improved to acquire higher quality vein images?
- How can the camera settings and illumination be controlled to acquire images with different exposure levels?
- How can multiple Low Dynamic Range images of different exposures be combined to create a High Dynamic Range image?
- What criteria can be used to evaluate the pixel quality of each acquired LDR image for HDR reconstruction?
- To what extent does High Dynamic Range translate to recognition performance?

Looking ahead

- Acquiring images & controlling illumination directly from the Pi & transferring/accessing acquired images from Matlab for HDR algorithm
- Improving HDR reconstruction

Appendix



(a) Input images

(b) HDR reconstructions