Assignment #5

Image Based Biometry 2022/23
Faculty of Computer and Information Science
University of Ljubljana

Biometric Pipeline

I. Introduction

Your task is to join up existing approaches you have evaluated for recognition and detection (the 1st and the 2nd assignments), evaluate them on the new data you have prepared (3rd assignment) and make improvements (perhaps incorporate some techniques from the 4th assignment) and/or add new recognition/detection approaches. In this assignment you are more on your own than before and it is up to you to decide what kind of improvement will you implement. Since the resulting plots of your research will take more space this time, you are limited to up to three pages (still try to target two, if possible).

Due to the higher workload in your third assignment this assignment is optional. You do not have to complete it, if you do not have time/energy (you need 50 points from all the assignments in order to pass the lab part, of the course).

II. Things You Need to Do

- Process the data:
- – split the data into train–validation–test.
  - If you will be doing detection (as opposed to segmentation) prepare bounding-box annotations based on the binary masks (one of the simple approaches is to call OpenCV's findContours function).
- Connect the output of the segmentation/detection part to the recognition part.
- Run three groups of evaluations:
- – segmentation/detection (the same as the 2nd assignment, with optional additional approaches),
  - recognition on cropped images (the same as the 1st assignment, with optional additional approaches),
  - pipeline (recognition on images that were cropped based on the segmentation/detection).
- Implement and evaluate one or more improvements. Below is a list of some ideas, feel free to come up with your own:
- – instead of only identity prediction make gender or ethnicity prediction (based on the labels you annotated in the dataset),
  - do covariate analysis – compare recognition performance based on gender/ethnicity/left/right,
  - fetch multiple approaches from GitHub and evaluate them in your pipeline (such as HOG [1]),
  - retrain YOLO on the supplied dataset,
  - use some existing segmentation model and retrain it (such as Refinenet),
  - implement multiple preprocessing techniques for one or multiple parts of the pipeline,
  - make a fused predictions (e.g. fuse LBP and ResNet (pretrained on the ImageNet) feature vector),
  - some type of multi-region sampling (split up an image into overlapping sections and derive features from there),
  - instead of doing ranking in the end directly, make use of Support Vector Machine (SVM),
  - etc.

III. Grading

To help you with the report and programming goals, the following aspects below will be graded.

- **12 pts** Ingenuity of your improvements/evaluations (please describe your solution(s) well).
- **5 pts** Quality of the report.
- **1 pts** Reporting of (with plots) detection accuracy (with the measure of your choosing) for all the approaches compared.
- **1 pts** Reporting of (with plots of your choosing) classification accuracy (with the measure of your choosing) for all the approaches compared.
- **1 pts** Reporting of (with plots of your choosing) the whole pipeline classification accuracy (with the measure of your choosing) for all the approaches compared.

IV. Materials

- **Literature** Google Scholar and Papers With Code are a good start. Some links that may help you with some parts (to get some ideas):
  - An example of LBP and CNN fusion [2] (but you can also simply stack both feature vectors): https://openaccess.thecvf.com/content_ECCVW_2018/papers/11134/Wetzer_Towards_automated_multiscale_imaging_and_analysis_in_TEM_Glomerulus_detection_ECCVW_2018_paper.pdf
  - An old example of traditional image feature extraction approaches [3]: https://tinyurl.com/3u7pve77

  - SVM (https://en.wikipedia.org/wiki/Support_vector_machine), a toy example: https://tinyurl.com/u9r9f6d2.
- **Code** Please follow the PEP8 guidelines (https://peps.python.org/pep-0008/) and comment a lot.
- **Data** Use the data you have prepared available here: https://tinyurl.com/ibbdataset.
- **Report** Please, begin with the template available here: https://www.overleaf.com/read/ppbyvnbqfyrt and limit yourself to three pages this time.

V. Submission

There is one STRICT deadline (unfortunately semester ends and the exam follows soon):

- January 14 (Saturday): submission of your code and the report (PDF) on Eučilnica: https://ucilnica.fri.uni-lj.si/mod/assign/view.php?id=51397.

References

[1] N. Dalal and B. Triggs, "Histograms of oriented gradients for human detection," in *2005 IEEE computer society conference on computer vision and pattern recognition (CVPR'05)*, vol. 1. Ieee, 2005, pp. 886–893.

[2] E. Wetzer, J. Lindblad, I.-M. Sintorn, K. Hultenby, and N. Sladoje, "Towards automated multiscale imaging and analysis in tem: Glomerulus detection by fusion of cnn and lbp maps," in *Proceedings of the European Conference on Computer Vision (ECCV) Workshops*, 2018, pp. 0–0.

[3] Ž. Emeršič, V. Štruc, and P. Peer, "Ear recognition: More than a survey," *Neurocomputing*, vol. 255, pp. 26–39, 2017.