Applied Deep Learning
The shape of the urine stream

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***Abstract*—During the lecture Applied Deep Learning the goal is to find an appropriate problem to solve it with deep neural networks. The shape of the urine stream of males is an indicator for the healthiness of the prostate and the bladder. The goal in this work is to classify different shapes of urine streams which should provide the basis for a tool which can be used as a non-invasive method for measuring the healthiness of the prostate and the bladder.**

Keywords – urine, stream, prostate, bladder

I. Project Idea

Measuring the healthiness of the prostate or the bladder is today combined with a visit to a urologist and is at the same time an unpleasant situation for males. One of the indicators, the flow rate, can be measured with a clinical urine flow meter at a urologist. In addition to that, in a novel study [1] it could be shown that the shape of the urine stream of males is also a good indicator of the urine flow rate and orifice geometry of the penis (urethral meatus). Hence, the shape of the urine stream is a useful indicator for monitoring the health status of the prostate and the bladder. The maximum flow rate is used as an indication of an obstruction to urine flow which may be caused by prostate enlargement or various other conditions. In addition, low flow rate may be caused by problems in the contraction of the bladder, hence flow rate and associated urine stream shape along are not clear-cut diagnostic markers but are useful enough so that a patient or rather healthy male can monitor himself at home and can visit the urologist if necessary. That means also that the shape and flow rate of urine can be used as a tool since it provides a non-invasive method to monitor the health of the prostate and bladder. A clip of a typical simulated urine stream created with the help of the equipment of Wheeler et al. can be found on YouTube (https://www.youtube.com/watch?v=BXezbw_xWoE).
(the measurements are done with a ruler)

II. Type of Project

The project tackles a classification problem. Classifying healthy urine streams from atypical streams with a Convolutional Neural Network (CNN) [2] will be the goal. As the indicator, the wavelength of the streams will be measured. Hence, there will be three classes to classify: typical stream, wavelength to long, and wavelength to small. There was already a mail traffic with Prof. Knight who didn't mention an approach for classifying the wavelength of the stream (or other indicators of the urine stream) with Computer Vision (CV) or deep networks. Thus, the project type seems to be *Beat the stars*.

III. Data

Unfortunately, there are no real or artificial data samples which are provided by Wheeler et al. or elsewhere. Therefore, the data sets for training, testing, and validating will be created by myself. To simulate the stream and orifice of the penis a plastic piping tip of a cake decorating set will be used. In figure 1 the piping tip is shown.

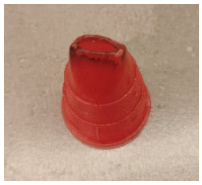

Figure 1 Piping tip to produce artificial urine streams.

The opening of the piping tip in figure 1 was formed to produce the desired shape of the stream which is shown in figure 2.

Figure 2 It is clear that the prepared piping tip creates nice oval shaped water streams which is the desired stream shape. Due to less pressure, the oval forms are small.

The goal is to produce for every class at least 10 minutes of video material and make them publicly available.

IV. Work-Breakdown

A summary of the work-breakdown in days:

- Data collection: 2
- Knowledge building on programming deep networks: 10
- Designing, fine-tuning, and building the network: 15
- Deployment of the model in a service-like architecture: 3
- Writing the final report and preparing the presentation: 1

References

[1] Wheeler AP, Morad S, Buchholz N, Knight MM. The shape of the urine stream--from biophysics to diagnostics. PLoS One. 2012;7(10):e47133. doi:10.1371/journal.pone.0047133

[2] Alex Krizhevsky, Ilya Sutskever, and Geoffrey E. Hinton. 2017. ImageNet classification with deep convolutional neural networks. Commun. ACM 60, 6 (June 2017), 84–90. DOI:https://doi.org/10.1145/3065386

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