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MASTER'S THESIS
for
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Hand Pose Estimation with CNN for Generalized Hand Shape

Problem description:

Hand pose estimation is considered as a difficult task due to the high dimensionality of the kinematic model. The estimation problem is especially hard for a single image without prior information. Current state-of-the-art methods [2, 1] use Convolutional Neural Networks (CNN) to regress the hand pose directly from single image. However, in their methods, Cartesian coordinates of hand joints are directly regressed, such that invalid hand pose can occur. Recently, Zhou et.al. [4] added a kinematic layer into the CNN framework to force the network to predict realistic hand pose, but the hand shape (bone lengths, palm size etc.) used for the kinematic layer is fixed to a single person. Therefore their method lacks generalizability to a unseen hand. In a new hand pose dataset [3], hand data of different persons are recorded, this gives us the possibility to also integrate the hand shape parameters as a learning target into the current framework, where hand shape parameters indicates the palm's shape and the bone length of each individual link. In this thesis, we will construct a learning framework, such that the hand shape parameters and hand pose can be jointly regressed.

Tasks:

- Literature research and background knowledge study.
- Dimensionality reduction for hand shape parameters.
- Design and implement the learning framework.
- Preprocess and data augmentation for the dataset from [3], and train on this dataset.
- Evaluation of the results and documentation.

Bibliography:

- [1] Markus Oberweger, Paul Wohlhart, and Vincent Lepetit. Hands deep in deep learning for hand pose estimation. *arXiv preprint arXiv:1502.06807*, 2015.
- [2] Markus Oberweger, Paul Wohlhart, and Vincent Lepetit. Training a feedback loop for hand pose estimation. In *Proceedings of the IEEE International Conference on Computer Vision*, pages 3316–3324, 2015.
- [3] Shanxin Yuan, Qi Ye, Bjorn Stenger, Siddhand Jain, and Tae-Kyun Kim. Bighand2. 2m benchmark: Hand pose dataset and state of the art analysis. *arXiv preprint arXiv:1704.02612*, 2017.
- [4] Xingyi Zhou, Qingfu Wan, Wei Zhang, Xiangyang Xue, and Yichen Wei. Model-based deep hand pose estimation. *arXiv preprint arXiv:1606.06854*, 2016.

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