Karlsruhe Institute of Technology

IAI

Label Assistant: A Workflow for Assisted Data Annotation in Image Segmentation Tasks

31st Workshop Computational Intelligence, Berlin

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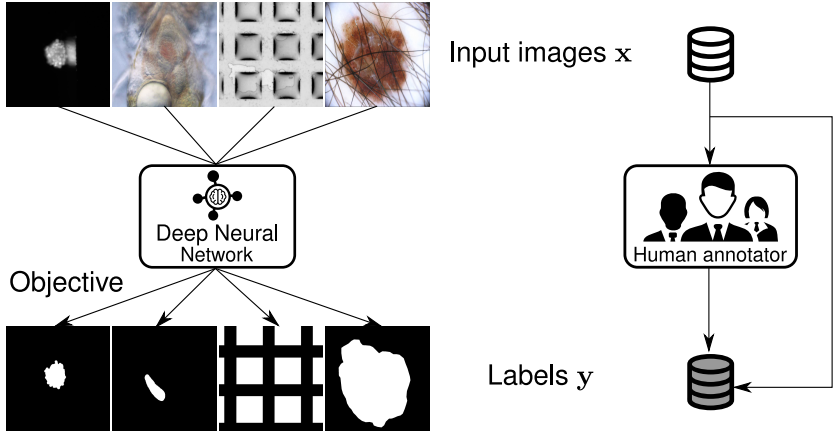
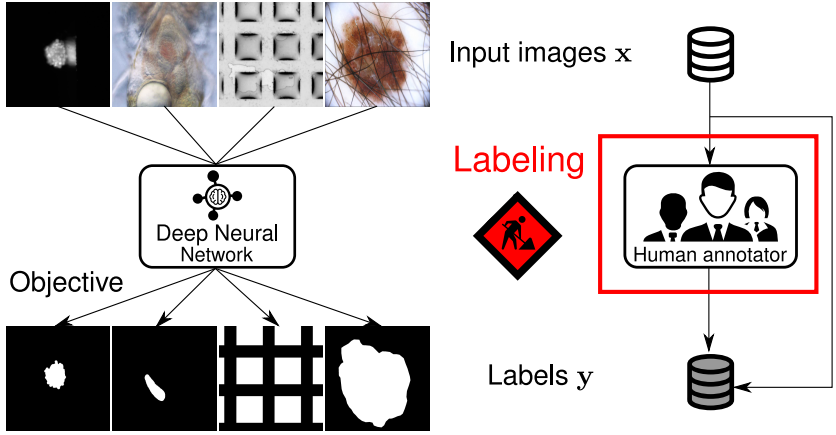
Outline

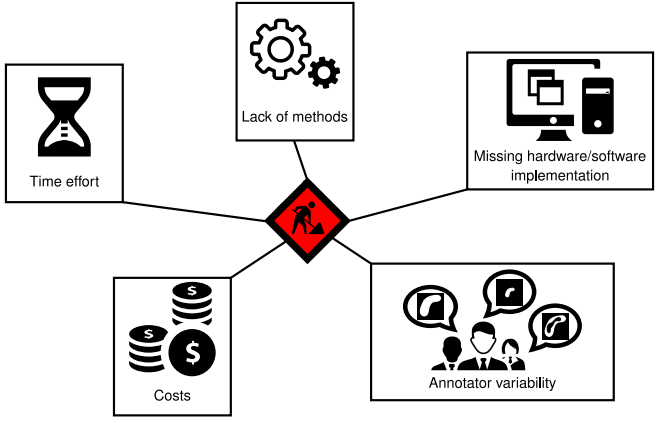
Introduction - Labeling



Introduction - Labeling

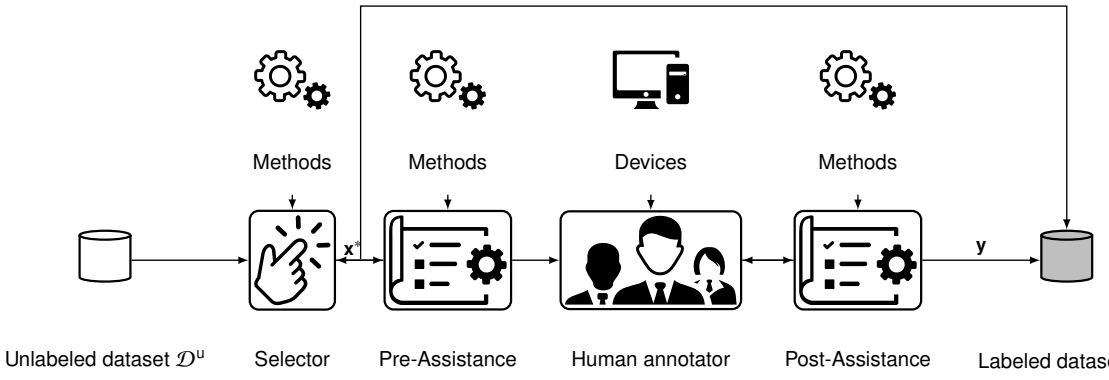


Introduction - Challenges



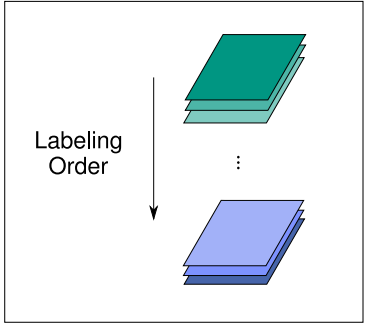
→ 🎯 **Objective:** Workflow for assistance to enhance labeling process [1, 2]

Workflow


Methods
Methods
Devices
Methods
x*
y
Unlabeled dataset $\mathcal{D}^{u}$
Selector
Pre-Assistance
Human annotator
Post-Assistance
Labeled dataset $\mathcal{D}^{l}$

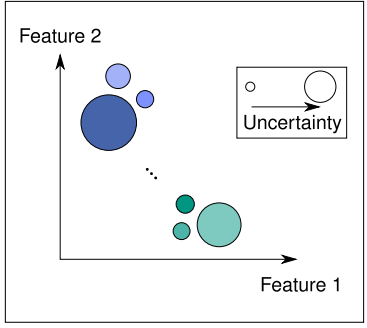
Selector

Status Quo

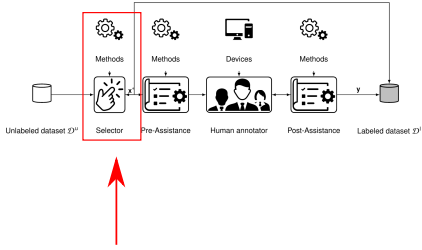


→ Squential sampling can be sub-optimal

Selector (Deep Active Learning)

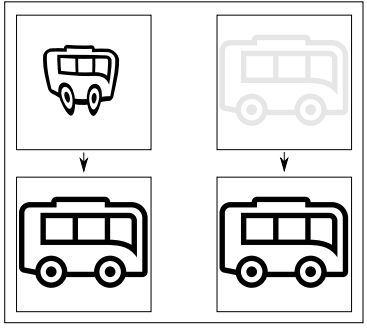


→ Use selection strategy (uncertainty, heterogenity, ...)



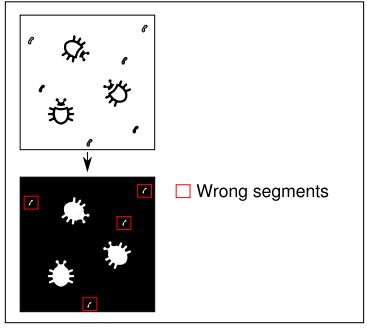
Pre-Assistance

Image Pre-Processing

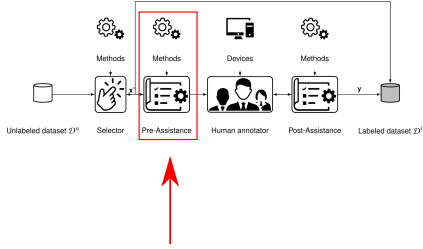


→ Prepare image to simply labeling for annotators

Pre-Labeling

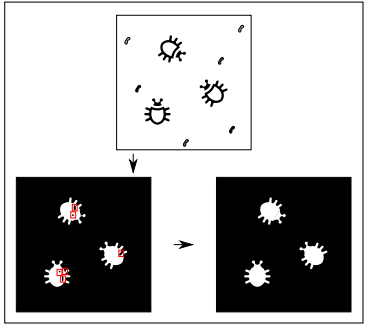


→ Pre-Labels to reduce labeling effort



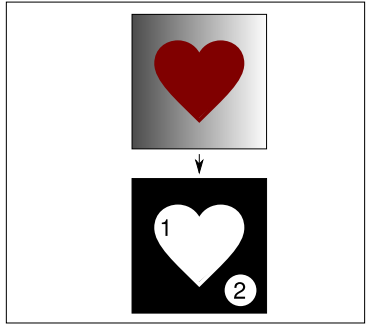
Post-Assistance

Post-Processing

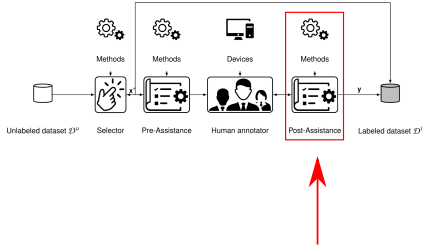


→ Post-Processing to improve label quality

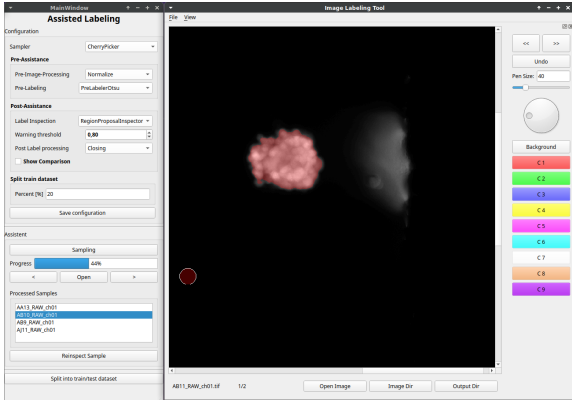
Label Inspection



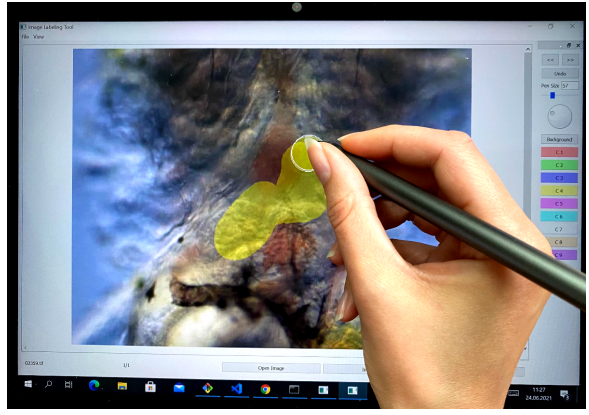
→ User warning based on defined criteria to enhance label quality



Implementation



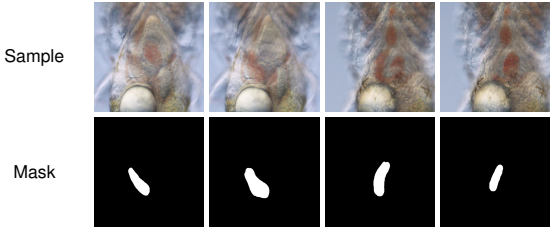
GUI [3]



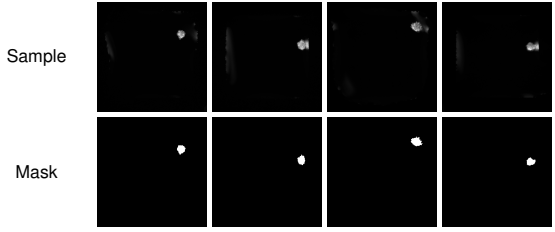
Support of different devices (tablet, laptop)/operating systems

Available soon (Git repository `https://git.scc.kit.edu/sc1357/kaida`)

Datasets



Medaka [4]



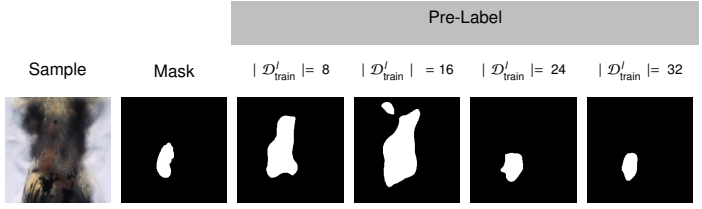
DMA Spheroid [5]

Result excerpts - Medaka

- Performance comparison: Different selection strategies to obtain labeled subset in contrast to labeling complete dataset (baseline)

	Configurations			
	Sequential	Random	Sequence-aware[1]	Baseline
$\lvert \mathcal{D}^{l}_{\text{train}} \rvert$	32	32	32	400
DSC_{test} in %	46.50	77.67	80.63	82.70

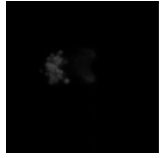
- Pre-Labeling via trained U-Net [6] on small dataset



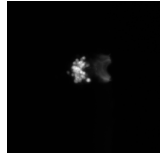
[1] Selection of one random sample per sequence

Result excerpts - DMA Spheroid

- Image Pre-Processing

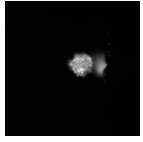


Raw

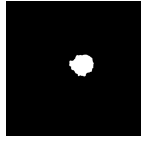


Pre-processed

- Pre-Labeling via Otsu thresholding



Sample



Mask

Pre-Label

80.18 %

DSC (Mask, Pre-Label)

Conclusion and Outlook

Conclusion

- Presentation of a generic workflow combing and extending various ideas of labeling enhancement
- Template for community usage in deep learning projects
- Software prototype which implements proposed workflow

Outlook

- Extension of methods depicted in each assistance module
- Integration of other tasks (e.g. classfication) in Label Assistant
- Open-source deployment of software prototype as `pip` package for community usage[2]

[2] Git repository `https://git.scc.kit.edu/sc1357/kaida`

Many thanks for your attention!

References I

[1] Davood Karimi et al. “Deep Learning with Noisy Labels: Exploring Techniques and Remedies in Medical Image Analysis”. In: *Medical Image Analysis* 65.5 (2020), p. 101759.

[2] Niall O’ Mahony et al. “Deep Learning vs. Traditional Computer Vision”. In: *Advances in Computer Vision*. 2019, pp. 128–144.

[3] Andreas Bartschat. *Image Labeling Tool*. Accessed: 2021-05-31, Available: `https://bitbucket.org/abartschat/imagelabelingtool`. 2019.

[4] Mark Schutera et al. “Machine Learning Methods for Automated Quantification of Ventricular Dimensions”. In: *Zebrafish* 16.6 (2019), pp. 542–545.

[5] Anna A. Popova et al. “Facile One Step Formation and Screening of Tumor Spheroids Using Droplet-Microarray Platform”. In: *Small* 15.25 (2019), p. 1901299.

[6] O. Ronneberger, P.Fischer, and T. Brox. “U-Net: Convolutional Networks for Biomedical Image Segmentation”. In: *Medical Image Computing and Computer-Assisted Intervention (MICCAI)*. 2015, pp. 234–241.