

Pose estimation for behavioural anomaly detection in pigs: comparative analysis of keypoint configuration and neural networks

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MANUAL SCORING LIMITATIONS

Manual scoring is time-consuming and labour-intensive:

- Limited temporal resolution - subtle or rapid events often missed
- Key problems faced by researchers & producers
- How can computer vision help?



HOW CAN COMPUTER VISION HELP?

- Automated, continuous monitoring without human fatigue
- Objective, quantitative metrics for posture and movement
- High throughput: simultaneous tracking of many animals
- Integration with different tools for early anomaly detection
- Can be used in different environments



OBJECTIVE



Keypoint configuration comparison

Evaluate different keypoint configurations for pose estimation



Neural Network Comparison

Evaluate 5 different Neural Networks for pigs tracking



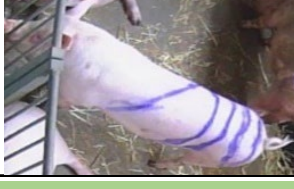
Performance Metrics

Compare trained models by tracking accuracy, computational efficiency, and robustness

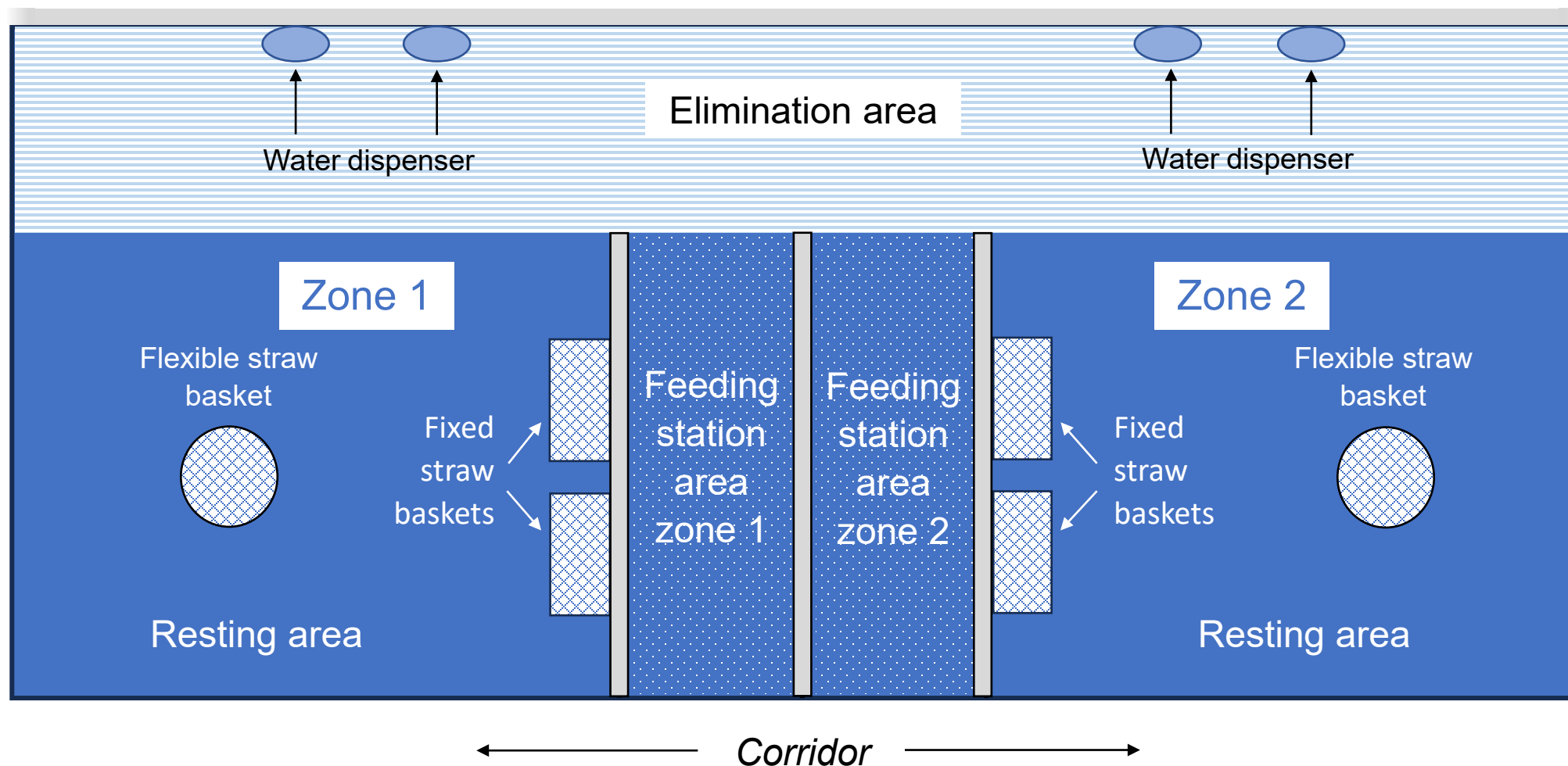


PIGS MARKS

- To enhance individual identification on video recordings, pigs were spray-marked weekly during routine weighing procedures, eliminating the need for additional direct handling.

Total N of marks	Rear marks	Back-rear combination	Front-rear combination
1			
2			
3			
4			
5			

MAP OF THE PEN



VIDEO ACQUISITION



Recording Parameters

Surveillance cameras installed 2.5m above daily recording from 7:00 AM to 8:00 PM, 15 fps, 320×240 pixels resolution, 15-minute AVI videos.

KEYPOINT CONFIGURATIONS

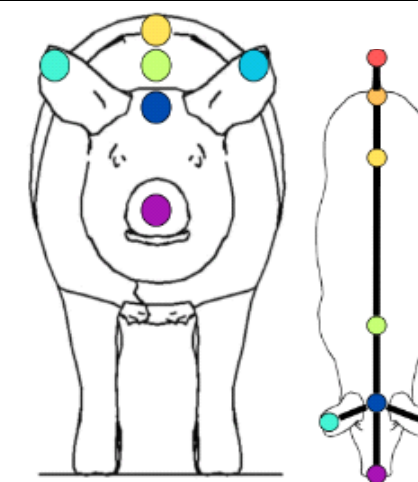
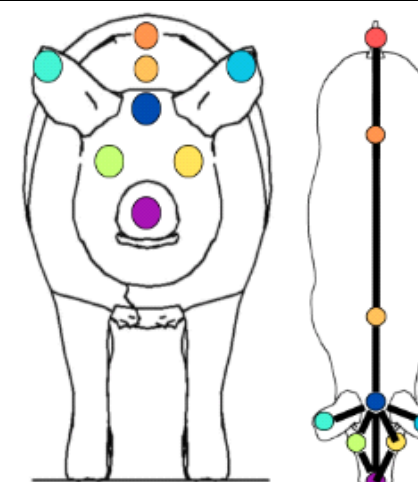
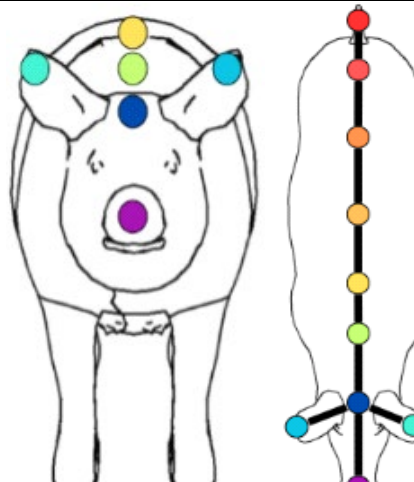
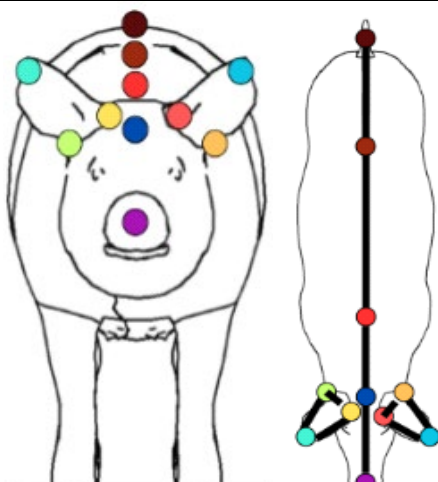
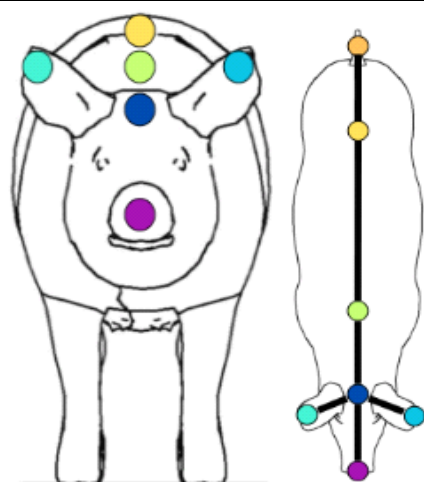
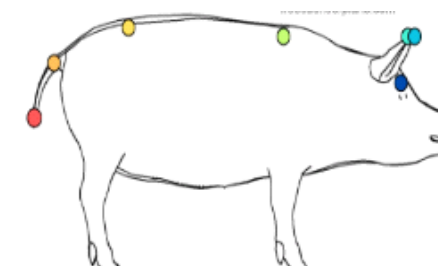
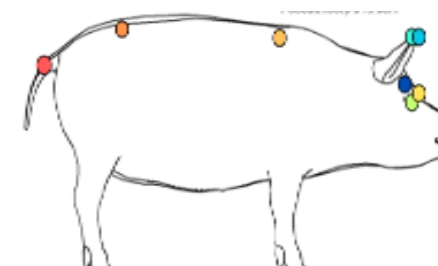
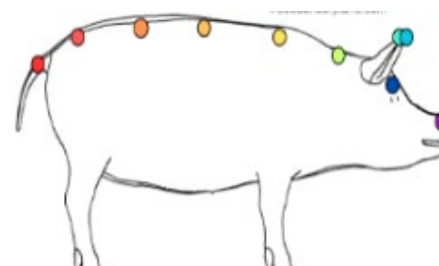
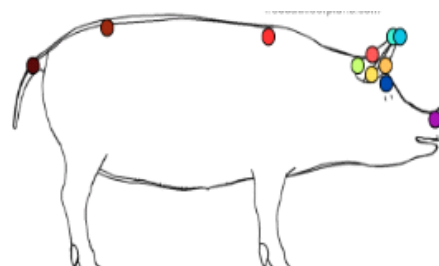
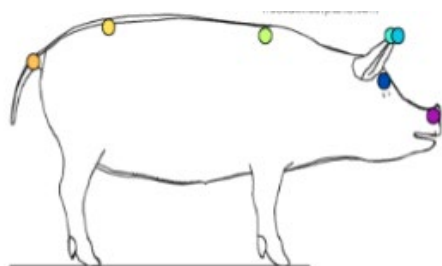
STD

EAR3P

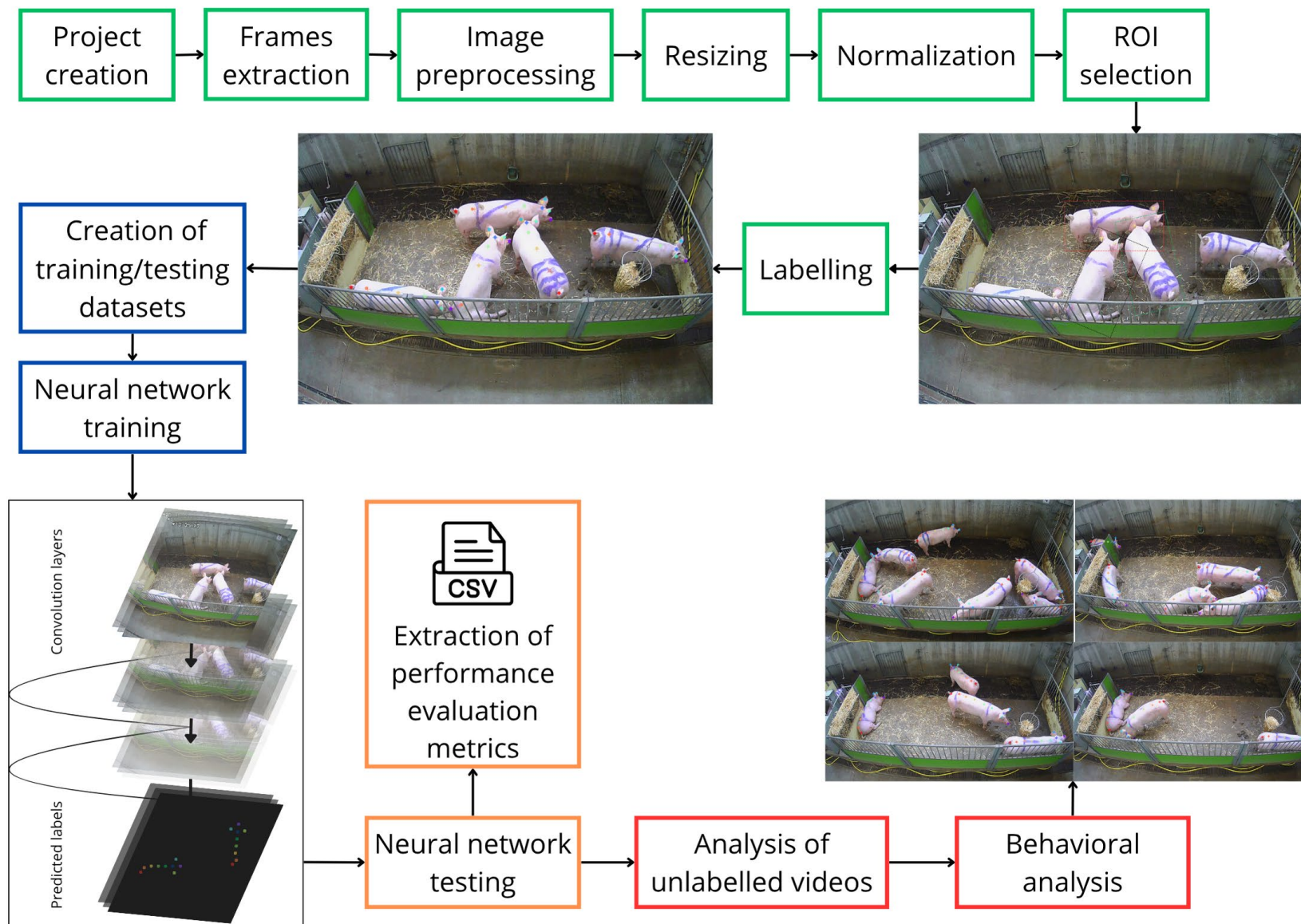
BODY5P

EYES2P

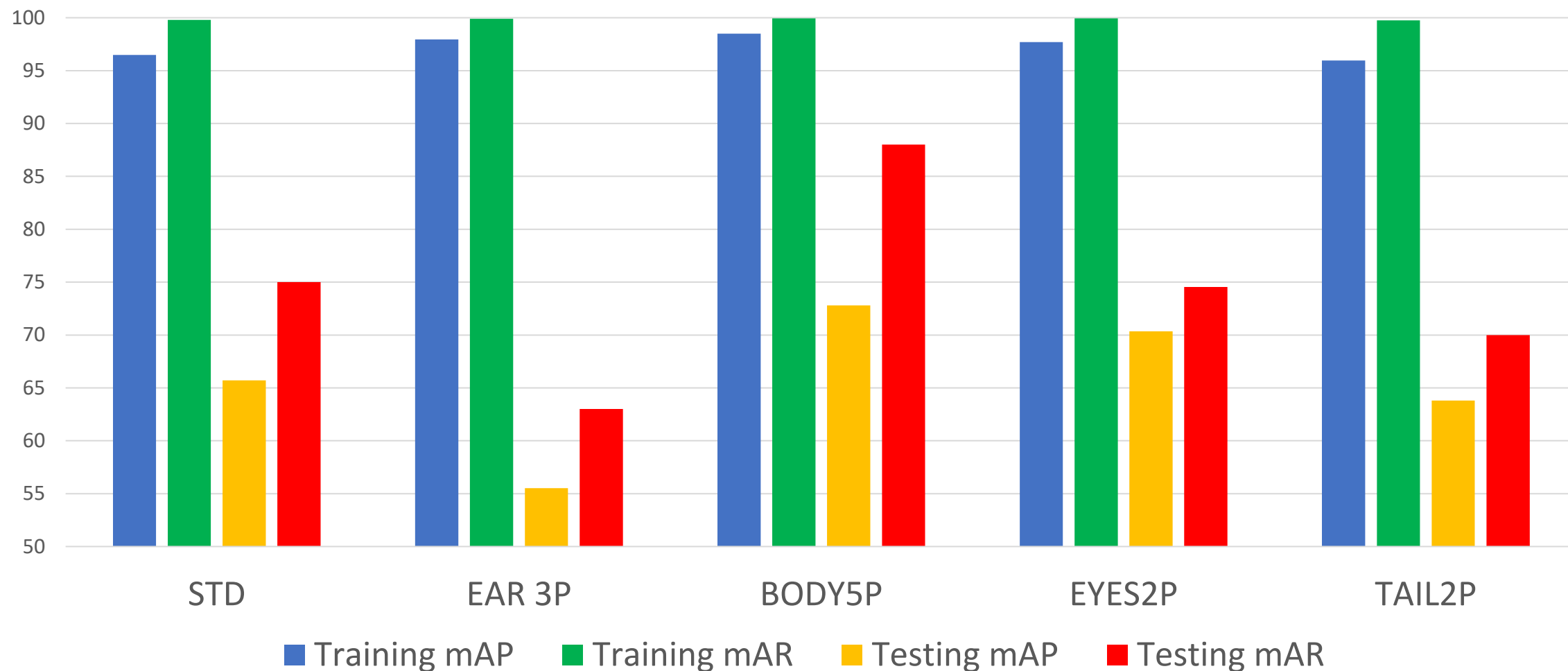
TAIL2P



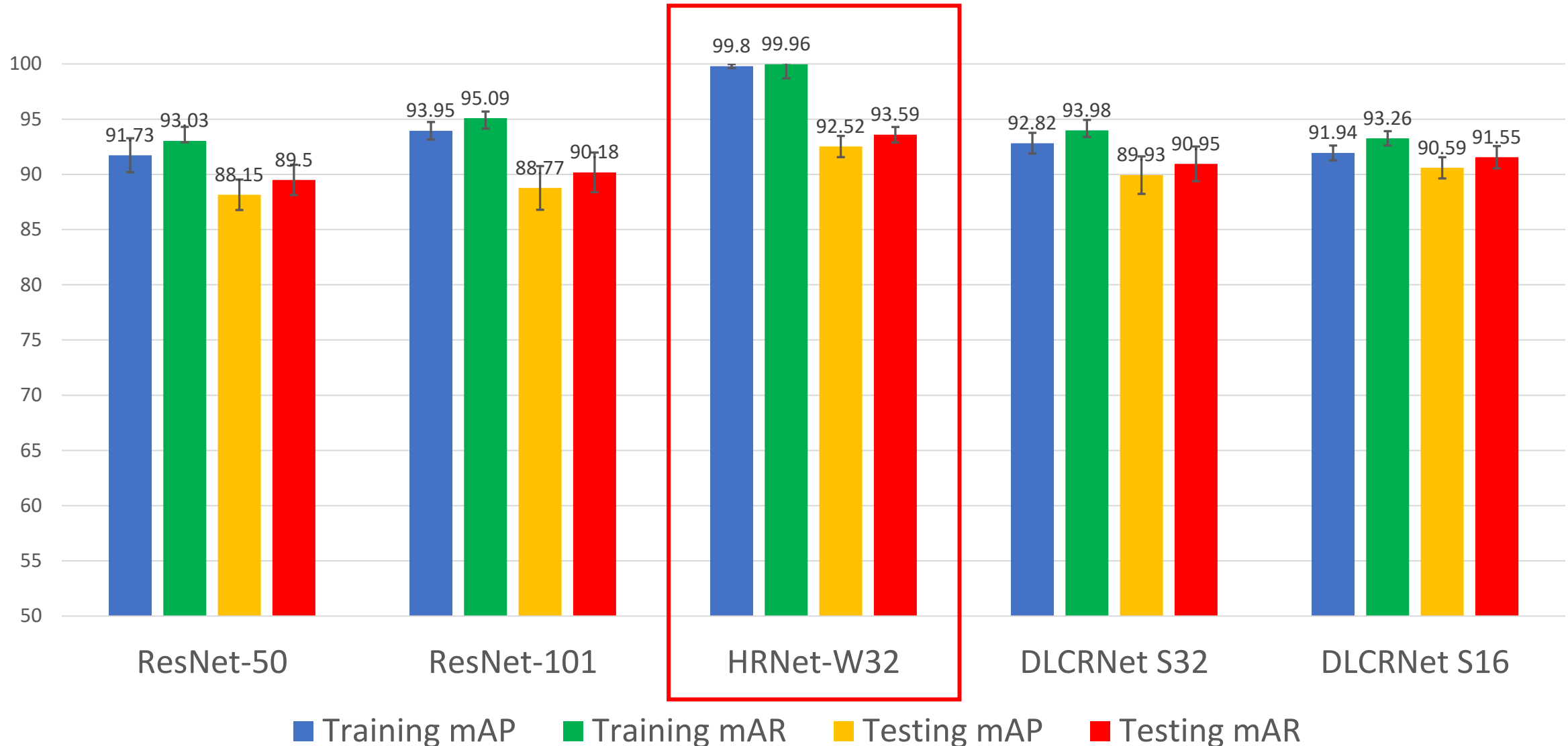
FLOWCHART



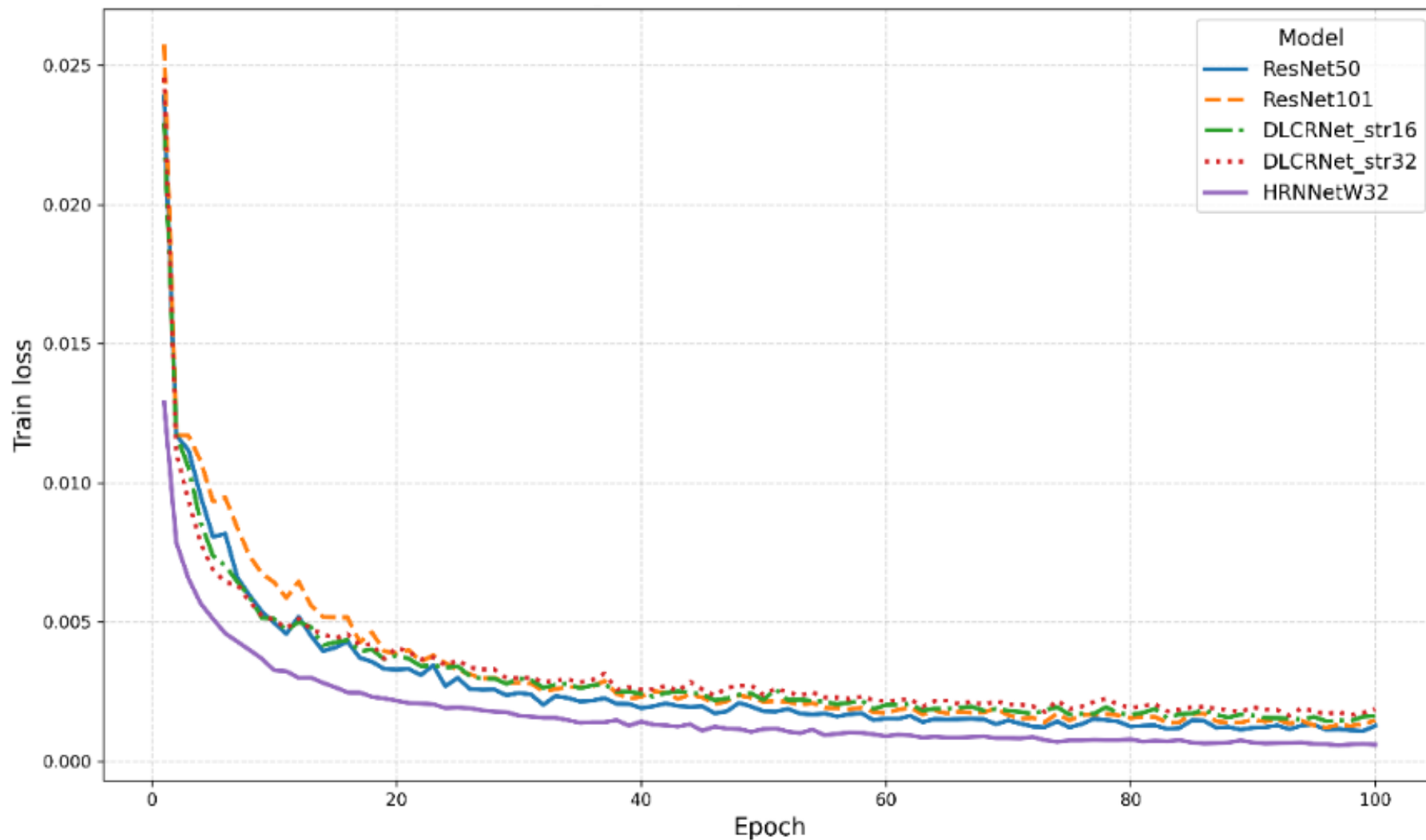
Keypoint configuration comparison



Neural network comparison



TRAINING LOSS COMPARISON

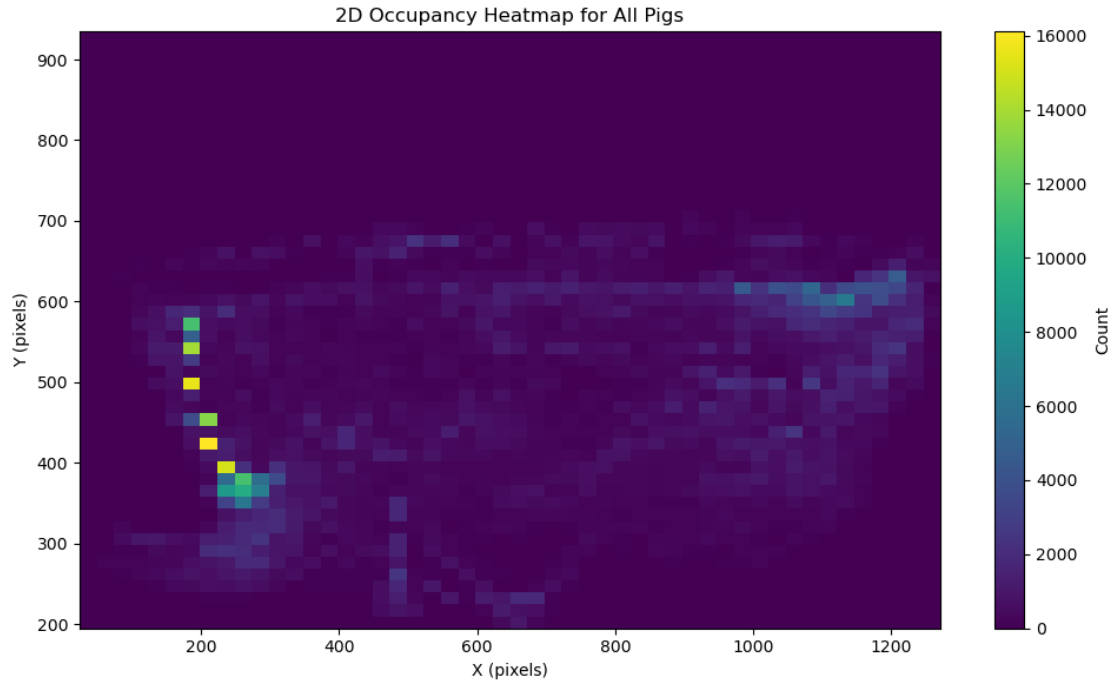




TEMPORAL CONSISTENCY

Bodypart	Dropout, %	Velocity, px/frame	Jerk, px/frame ²
Snout	46.0%	18.83	0.000054
Head	18.5%	24.25	0.000074
Left ear	28.8%	23.57	0.000051
Right ear	32.9%	23.33	0.000085
Body1	18.3%	24.34	0.000053
Body2	25.9%	25.95	0.000048
Body3	31.6%	24.94	0.000033
Body4	27.4%	25.33	0.000083
Body5	29.0%	21.21	0.000028
Tail	31.8%	16.97	0.000054

OCCUPANCY HEATMAP

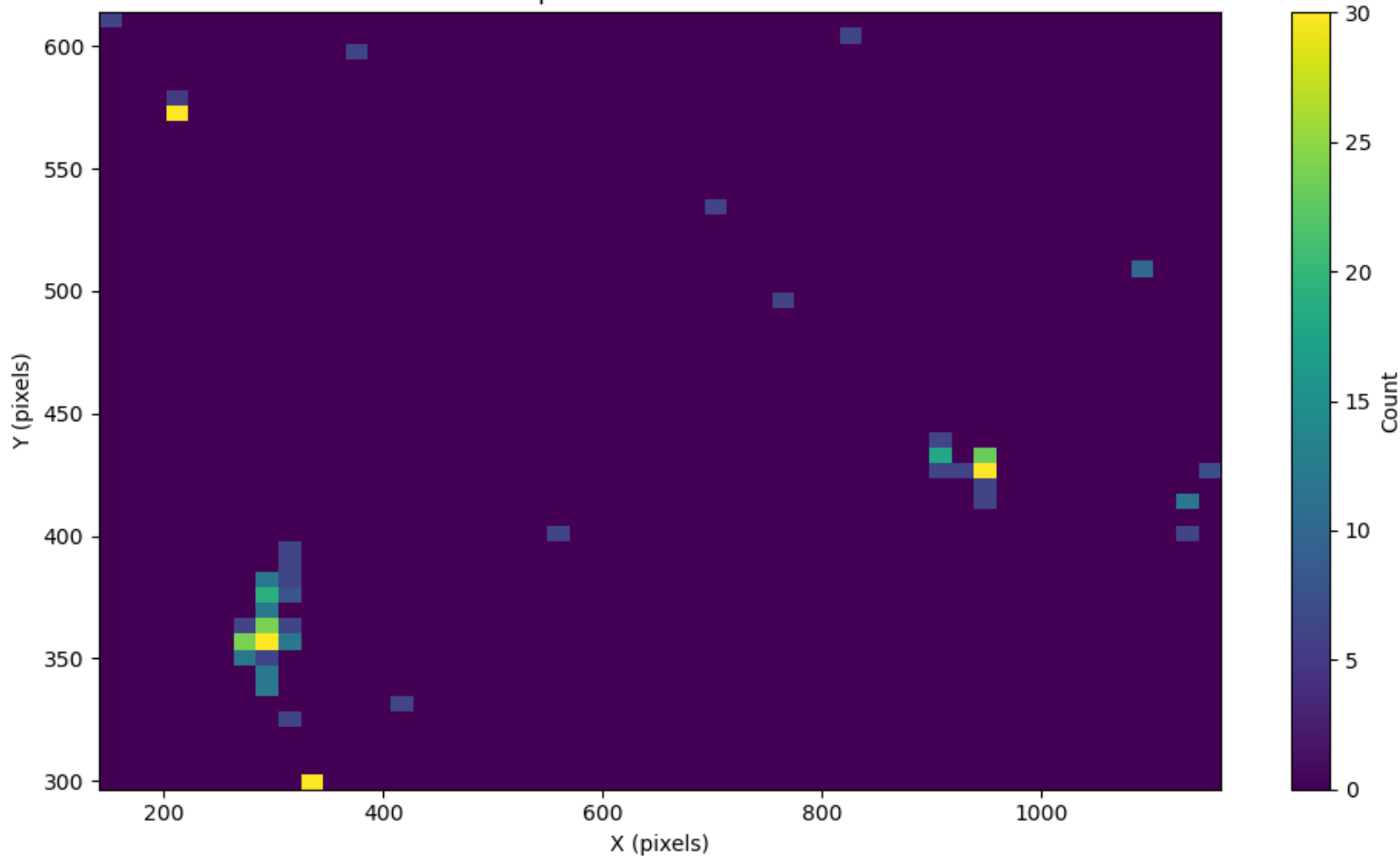


2D occupancy heatmap showing areas of frequent pig activity, with brightest regions indicating highest concentration.

- Left side of pen showed highest concentration of activity
- Distinct vertical yellow strip suggests presence of feeding station

TAIL-SNOUT INTERACTION HEATMAP

Heatmap of Tail-Snout Interactions



Methodological limitations:

- Proximity $\neq$ intentional interaction; co-occupancy may reflect pen design
- Fixed pixel thresholds ignore body size and camera perspective variability

CONCLUSION

Pose estimation is effective for tracking major anatomical landmarks in pigs under variable lighting and occlusion



Snout and ear key-points remain challenging under heavy occlusion



Lightweight architectures enable near - real-time inference even on limited-resource hardware



Model choice should align with farm needs



Future enhancements: integrate temporal models (LSTM/TCN) and multimodal inputs (depth, audio) to capture complex interaction dynamics

ACKNOWLEDGMENT

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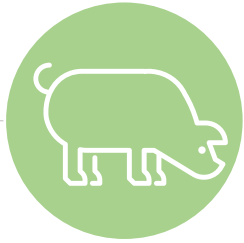


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Thanks!