An Inland Port Monitoring System using Aerial and Ground Imagery

inte great drones

U·H Universität Hamburg
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Motivation

Task: Identify transportation units (TUs) such as containers and trailers by recognising their ISO6436 or EN13044 compliant ID code
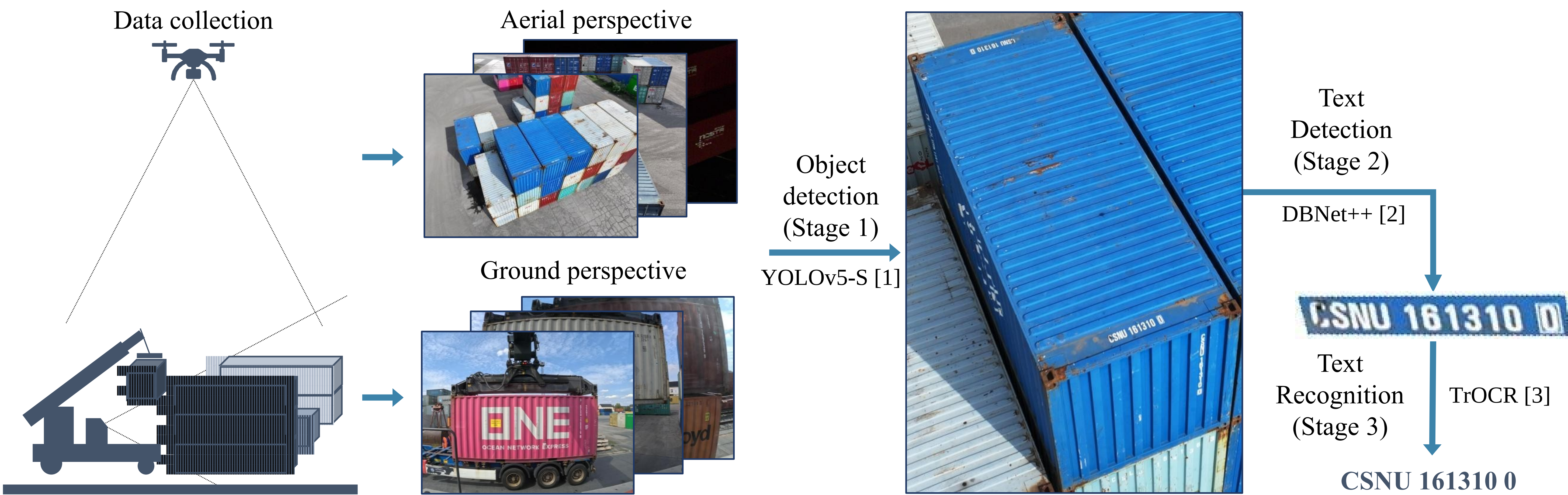
Problem:
• Multi-purpose terminals in inland ports handle a variety of TUs in a limited area
• Storage configurations and operational processes are constantly changing
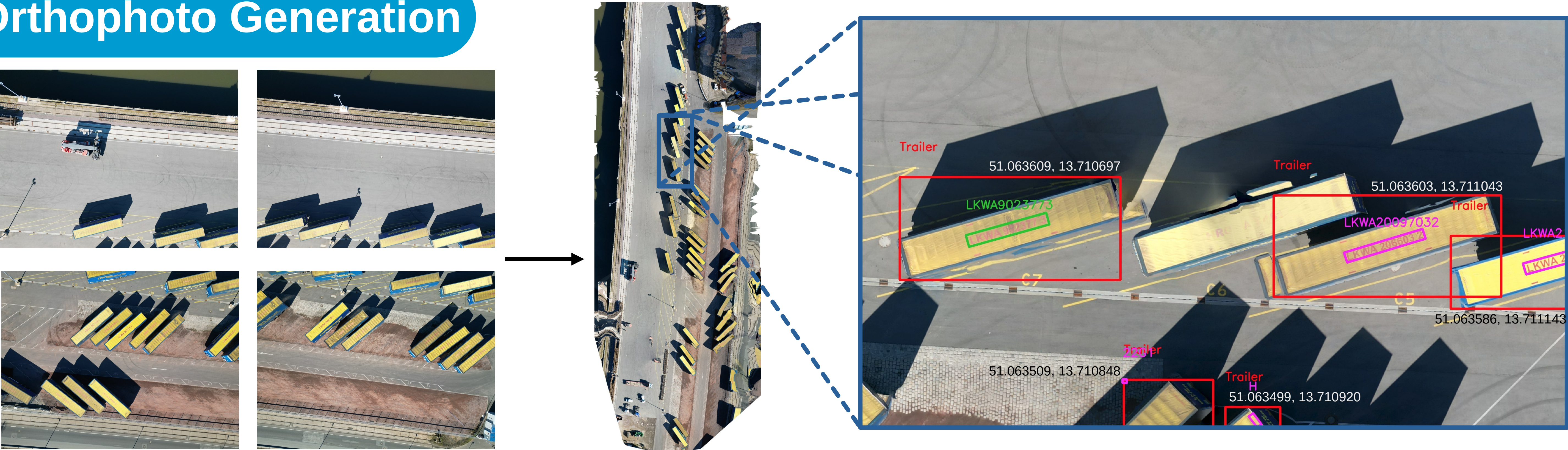• Fixed infrastructure is not feasible for this dynamic environment

Idea:
• Collect data from UAVs and sensor-equipped ground vehicles like reach stackers and trucks
• Detect TUs as a prior stage for text detection and text recognition to improve text detection

TU Identification System

Data collection

Aerial perspective

Ground perspective

Object detection (Stage 1)
YOLOv5-S [1]

Text Detection (Stage 2)
DBNet++ [2]

CSNU 161310 0

Text Recognition (Stage 3)
TrOCR [3]

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Orthophoto Generation

Trailer 51.063609, 13.710697
LKWA9023 23
Trailer 51.063603, 13.711043
LKWA2009/032
Trailer LKWA2
51.063586, 13.711143
Trailer 51.063509, 13.710848
Trailer 51.063499, 13.710920

Results

• Results of a previous work [4]:
  • 0.50 F1-score for detection
  • 0.16 CER for recognition
• Our results suggest robust detection and recognition also from UAV perspective

Stage	Model	Performance (metric)
TU Detection	YOLOv5s	0.71 (mAP@50)
Text Detection	DBNet++	0.87 (AR) 0.84 (AP) 0.85 (F1- Score)
Text Recognition	TrOCR	0.02 (CER)

Conclusion

• A system for identifying transportation units from both aerial and ground perspectives has been developed.
• Our system demonstrates robust performance across various operational conditions and provides a foundation for future development in port automation and optimisation.

References
[1] Jocher, Glenn, et al. (2021). ultralytics/yolov5: v6.0 doi: 10.5281/zenodo.5563715. Url: https://doi.org/10.5281/zenodo.5563715.
[2] Liao, Minghui, et al. (2020). "Real-time scene text detection with differentiable binarization." Proceedings of the AAAI conference on artificial intelligence. Vol. 34. No. 07.
[3] Li, Minghao, et al. (2023). "TrOCR: Transformer-based optical character recognition with pre-trained models." Proceedings of the AAAI conference on artificial intelligence. Vol. 37. No. 11.
[4] Teegen, Jana, et al. (2024). "Drone-Based Identification of Containers and Semi-Trailers in Inland Ports." 12th International Conference on Logistics and Maritime Systems.