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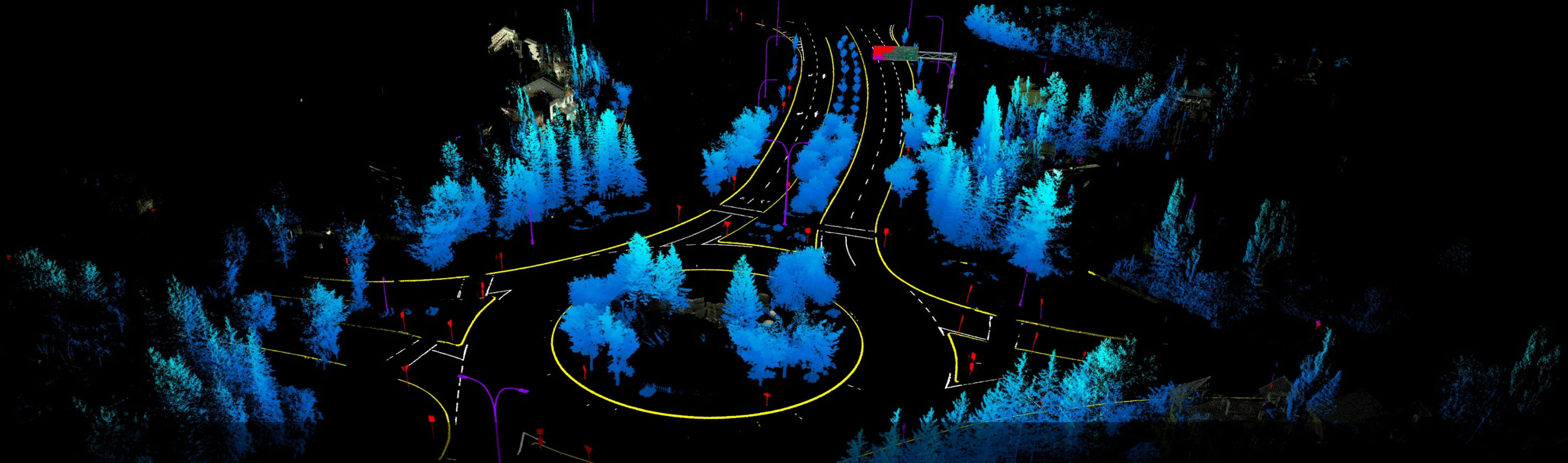
Unlocking the True Potential of AI for Asset Detection and HD Mapping: Robust Models using Limited Training Data

For session: HD Mapping & Autonomy



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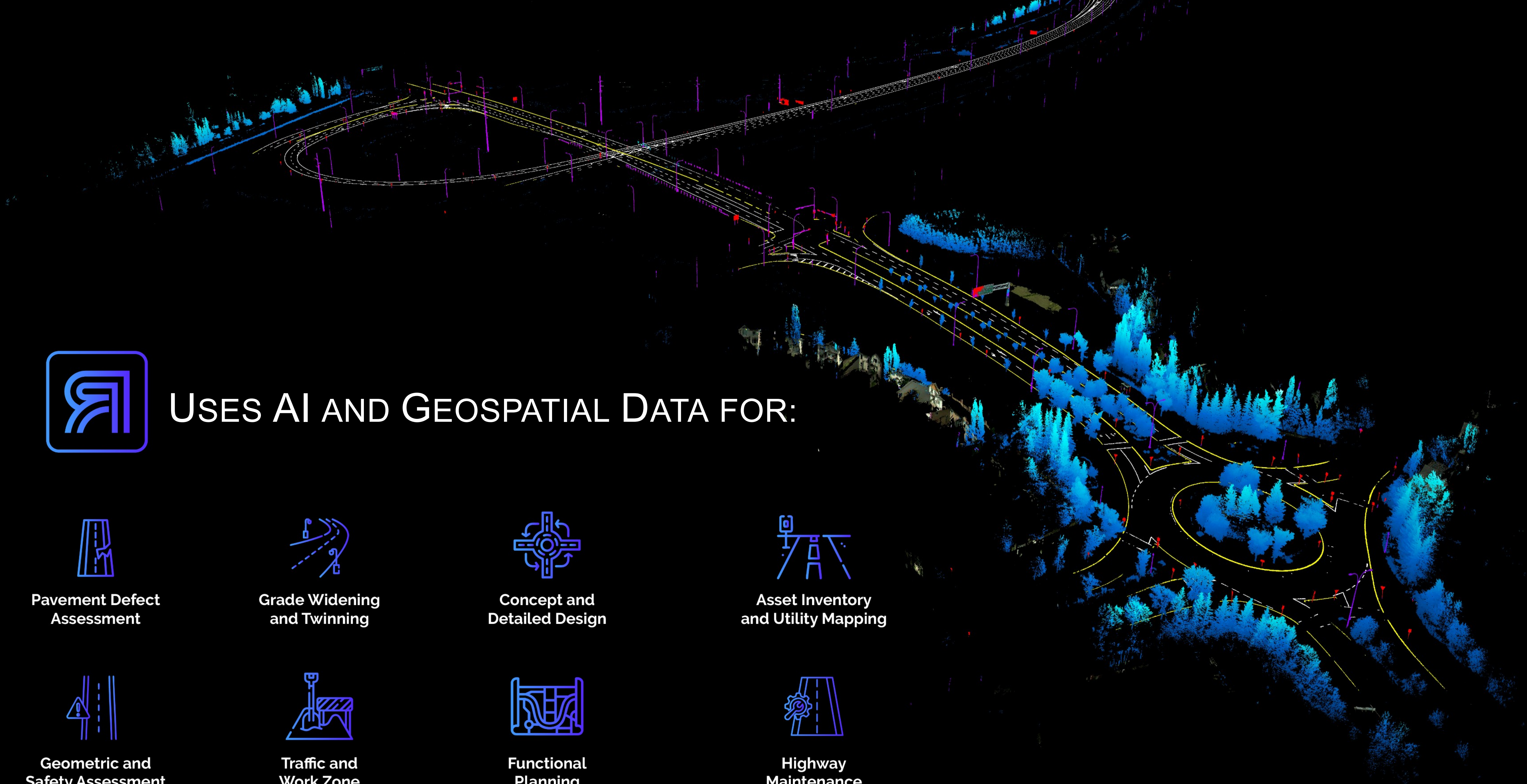
Geospatial World Forum 2026 – Amsterdam



Uses AI and Geospatial Data for:

Pavement Defect Assessment

Grade Widening and Twinning

Concept and Detailed Design

Asset Inventory and Utility Mapping

Geometric and Safety Assessment

Traffic and Work Zone

Functional Planning

Highway Maintenance

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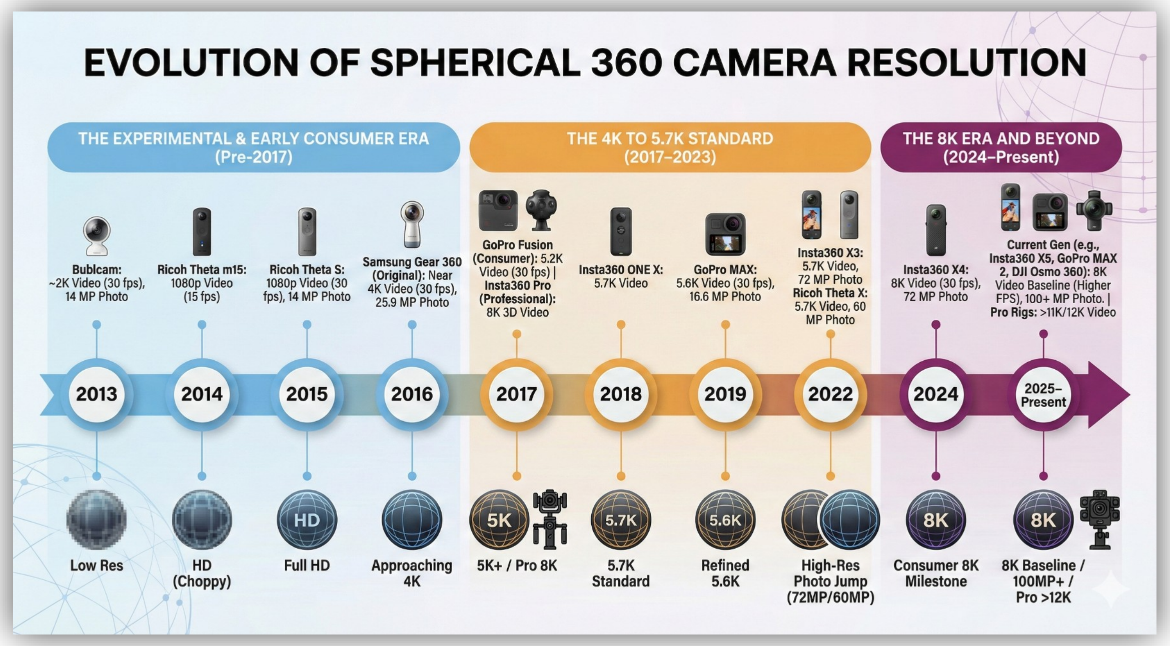
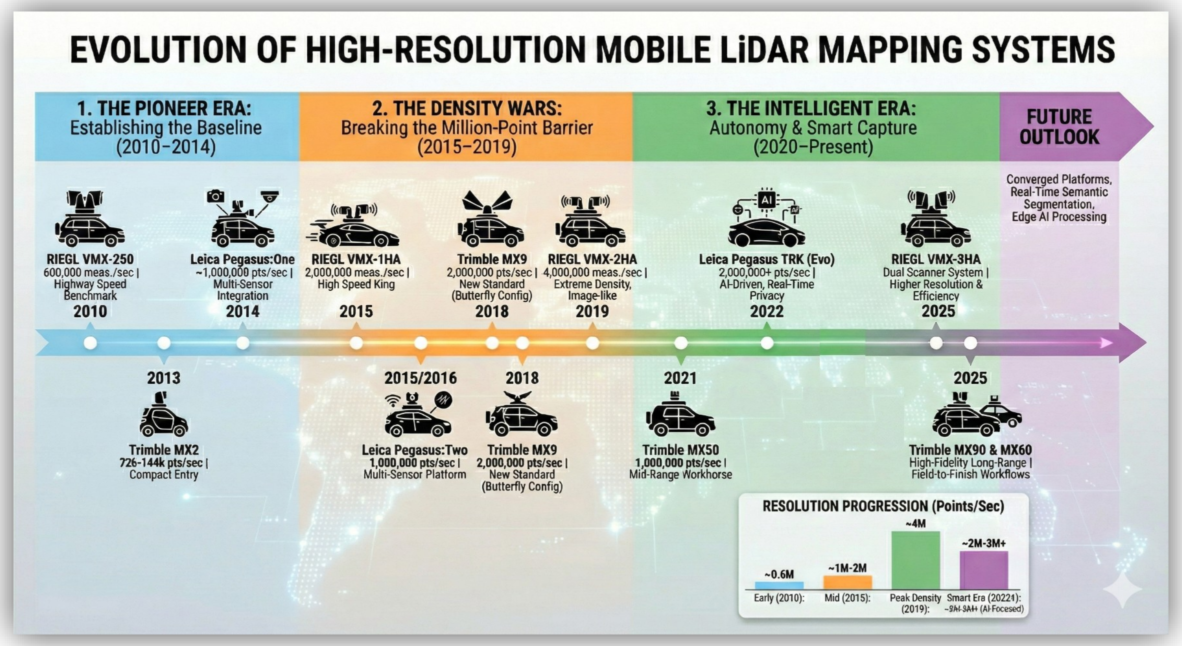
Building Robust GeoAI Models for Network Level Deployment

Geospatial Data Capture Technology

- Geospatial data acquisition technology has seen significant development in recent years.
  - Improvements have impacted data acquisition speed and resolution.





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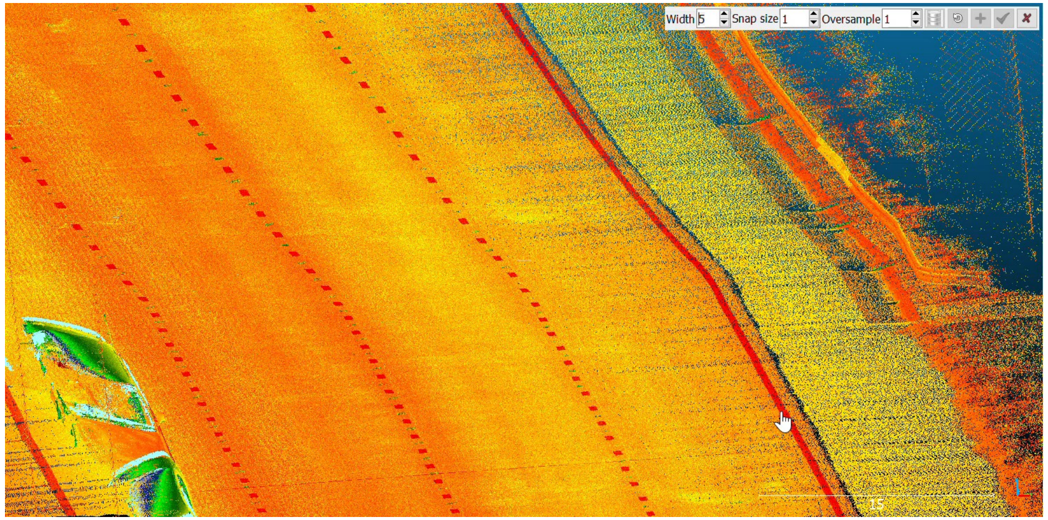
THE DATA PROCESSING BOTTLENECK

- Hardware development has resulted in better quality, higher resolution, more data, and larger files.

- Unfortunately, processing capabilities have not kept up.

- Object detection and feature extraction remain highly tedious and time-consuming tasks.



Highly labor intensive manual extraction of lane markings

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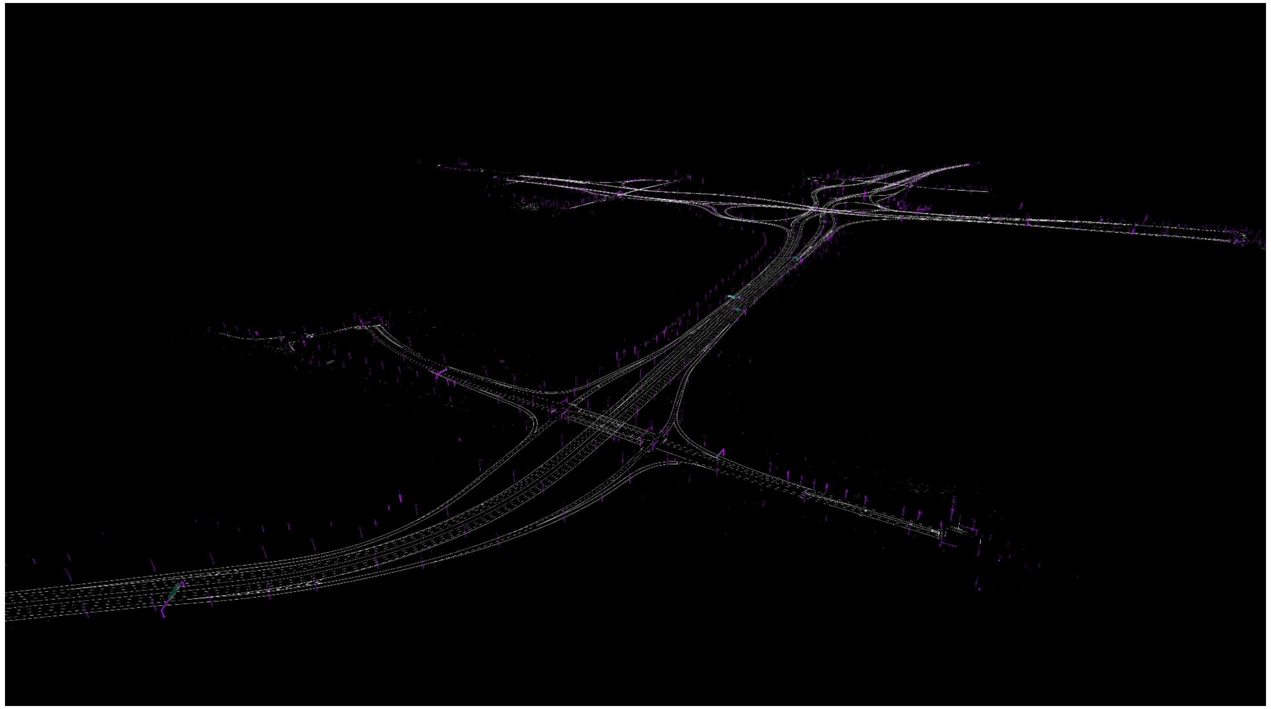
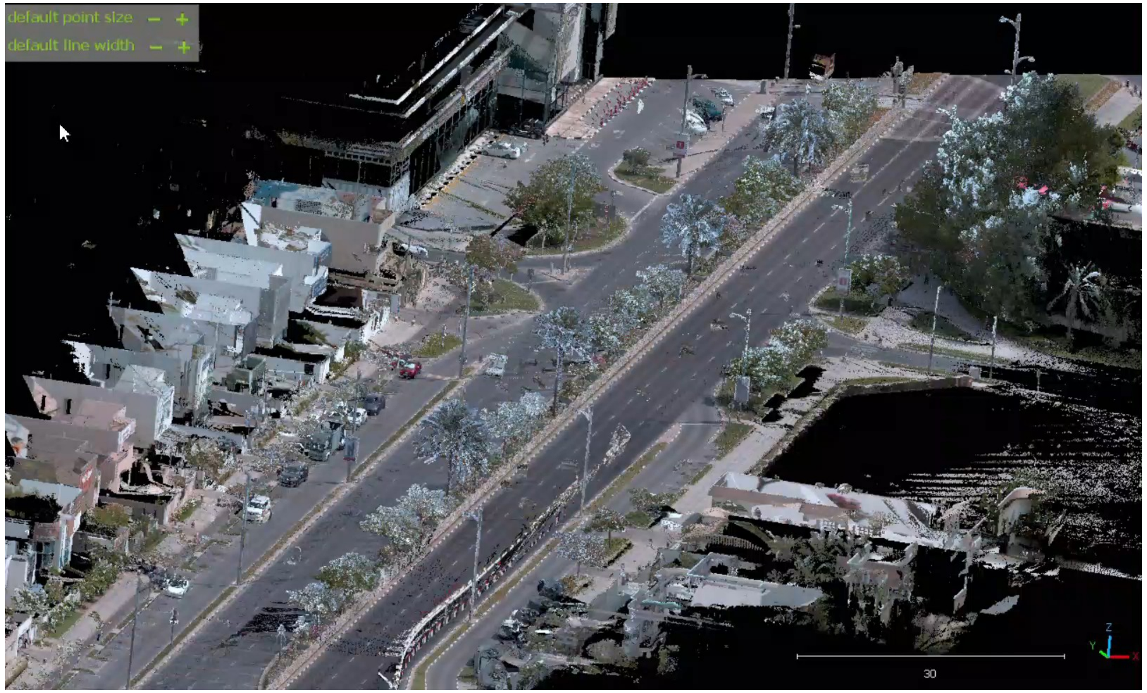
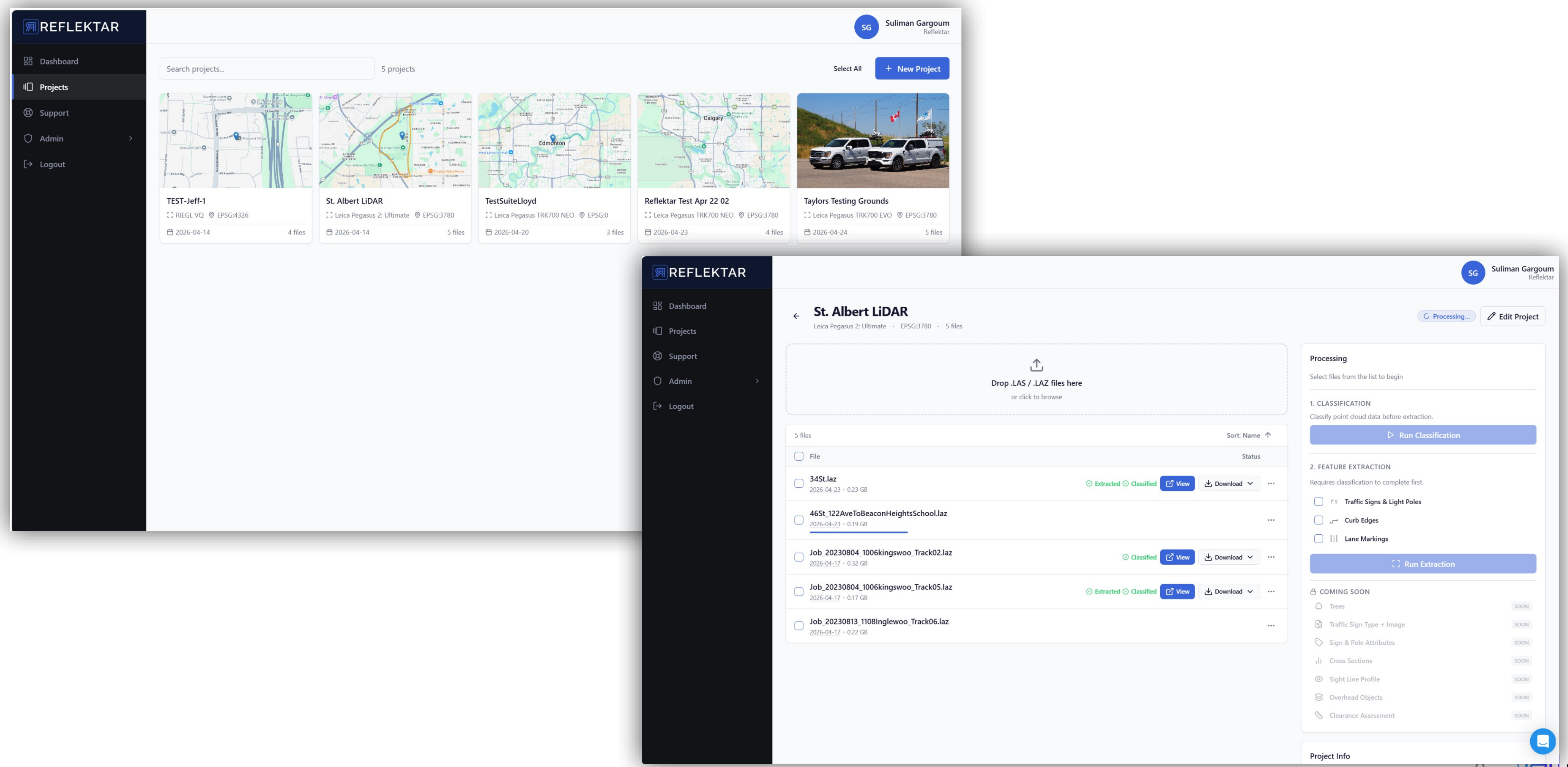
REFLEKTAR AI FOR MOBILE LiDAR



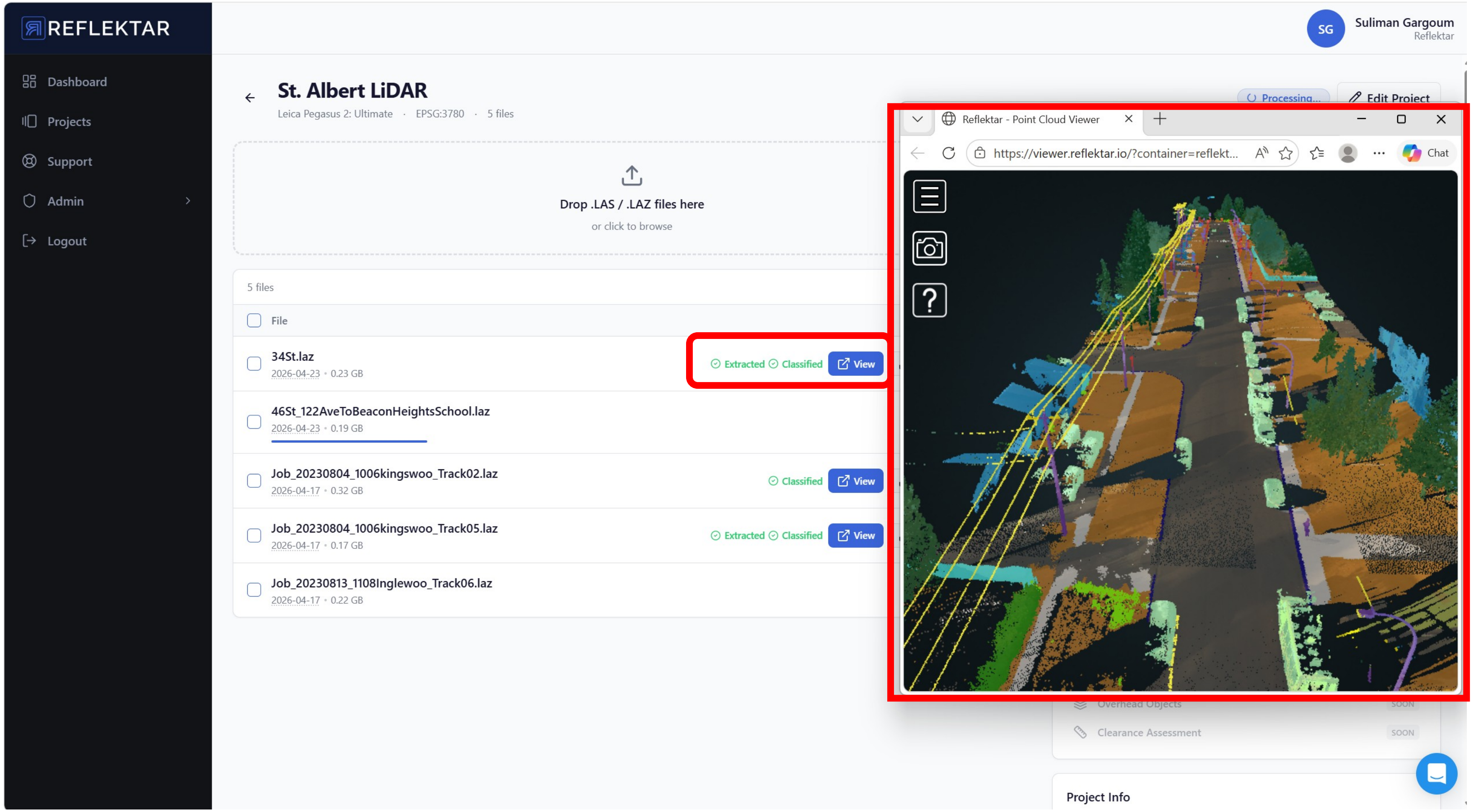
REFLEKTAR AI FOR MOBILE LIDAR

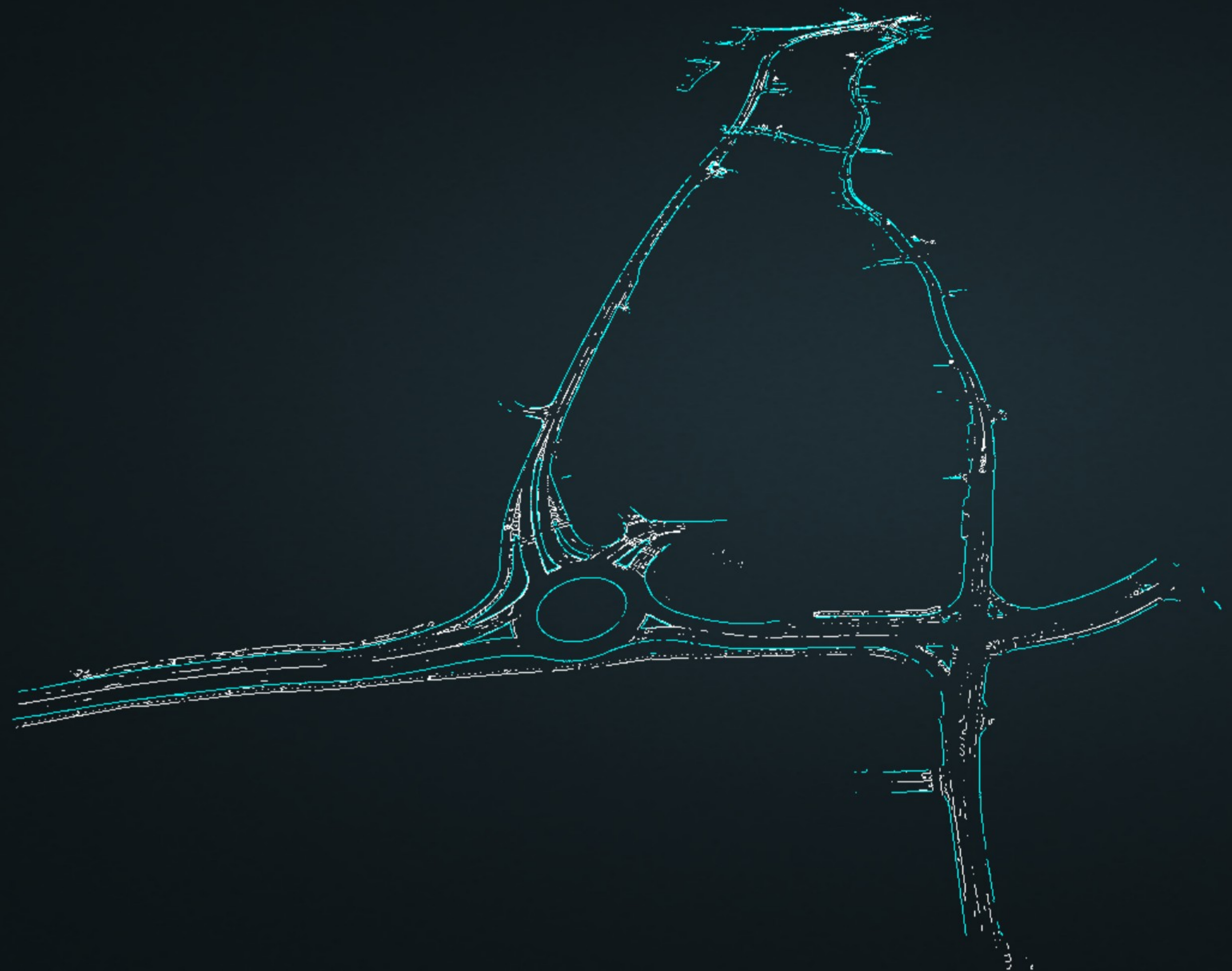


REFLEKTAR AI PORTAL



REFLEKTAR AI PORTAL





Data Heavey AI Models

- Although AI models have helped reduce the processing burden.
  - They require large volumes of training data
- This challenge is particularly a concern for small entities
- The challenge is also more significant for spherical imagery for which volumes of open-source labelled datasets are not as common.

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e=2147483647&v=beta&t=Mx_PajSvFfruZtKUsoNFOAfvATRib26aolqIDwxvXm0

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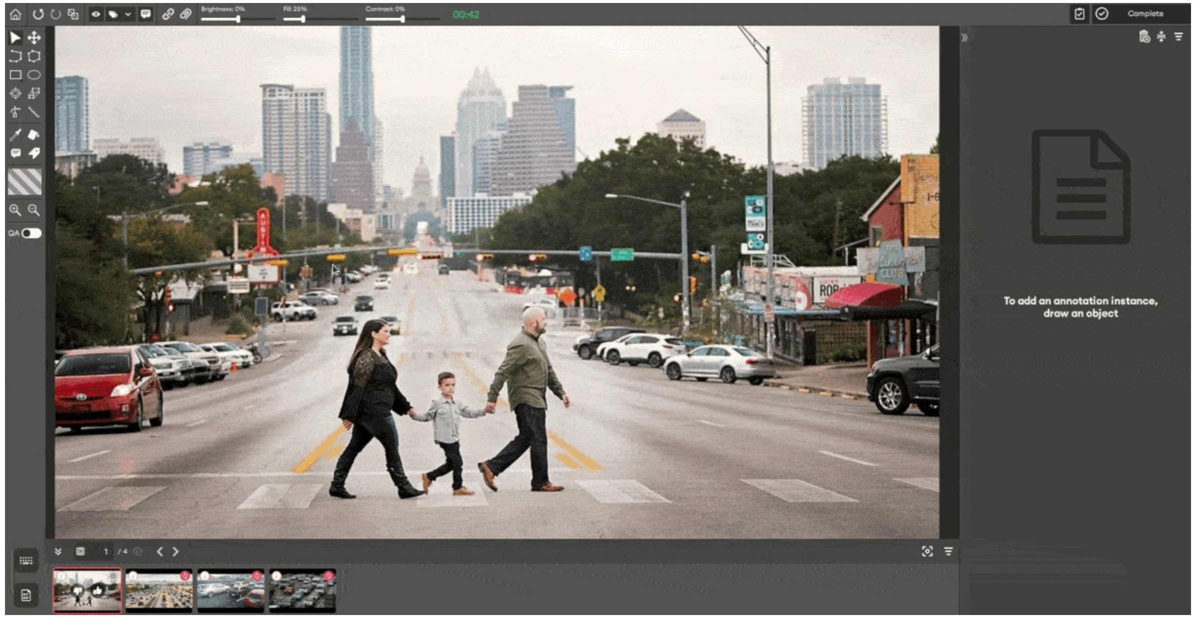
Data Labelling Challenges

- Training a supervised deep learning model requires manual labeling of thousands of images by experts.

- A trained team must manually identify and label objects of interest.



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THE CURRENT MODEL TRAINING PROCESS

- To obtain reasonable accuracy and an acceptable level of robustness 1000s of images must be labelled.
- Labelled data must also be diverse enough to avoid class imbalance
- Therefore, an alternative approach for flexible, fast adaptation to new classes is needed

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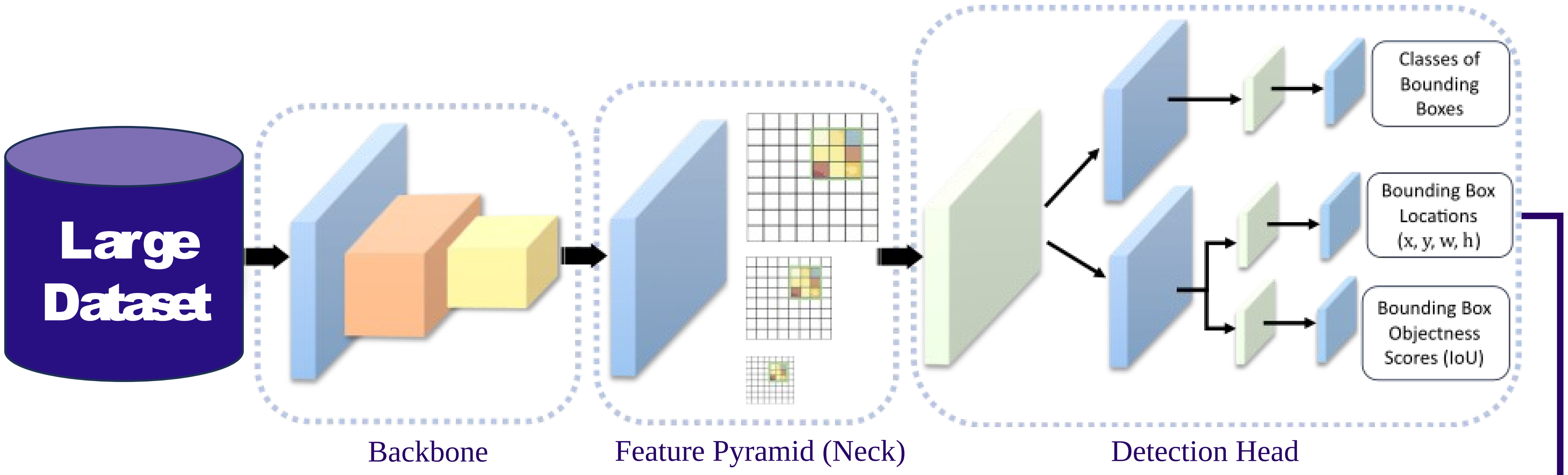
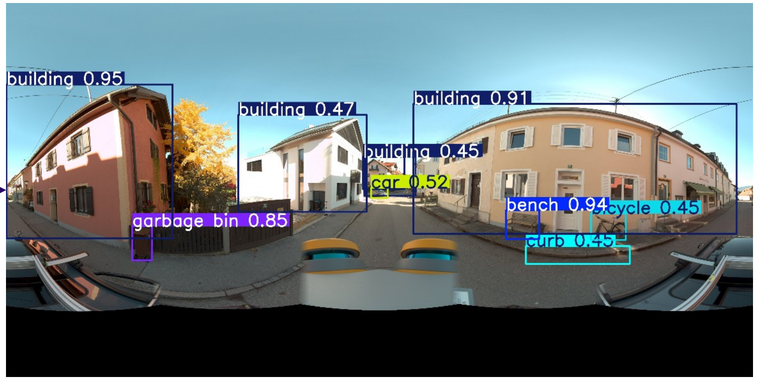
Classical Object Detection



Prediction



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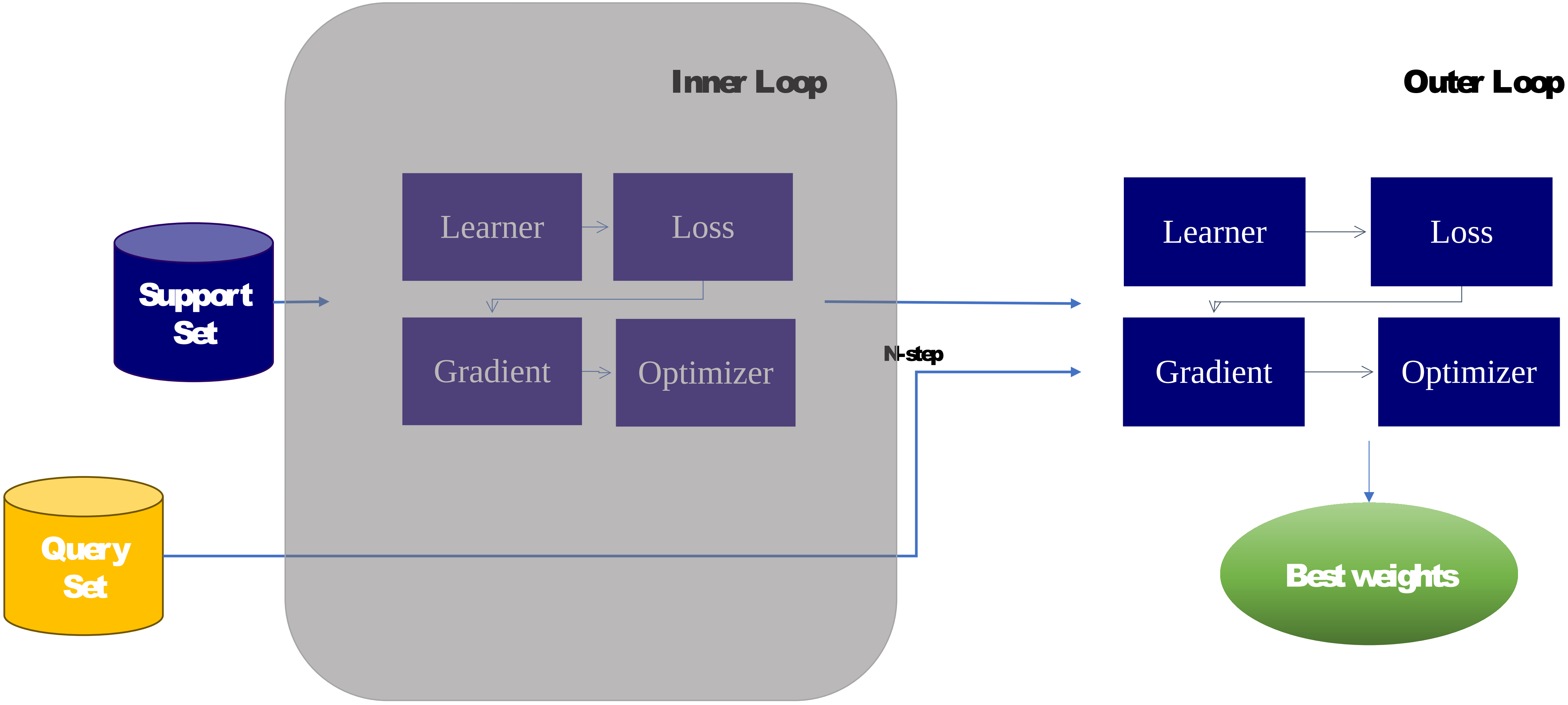
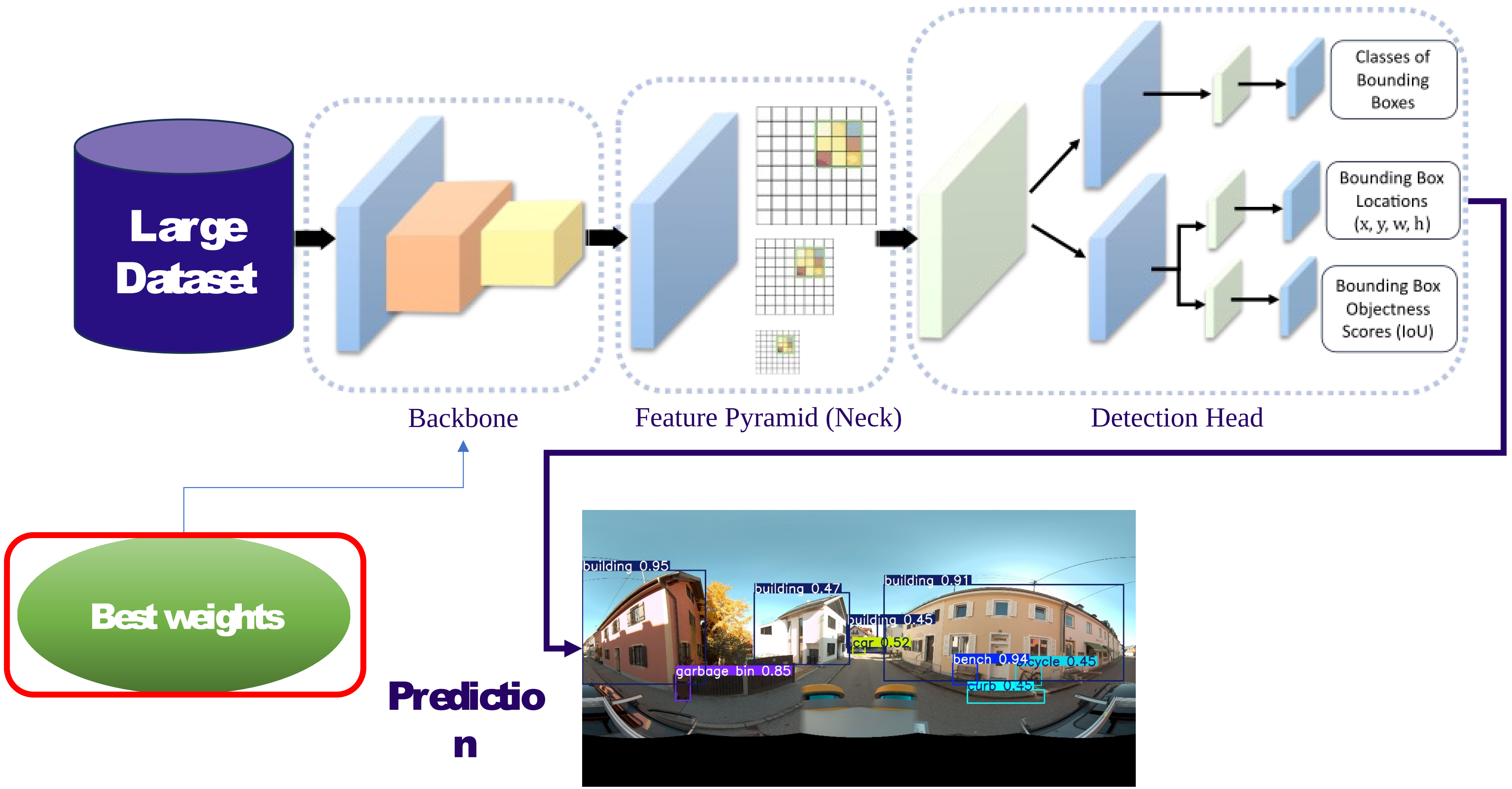
META-LEARNER BASED OBJECT DETECTION



Meta-Learner Based Object Detection



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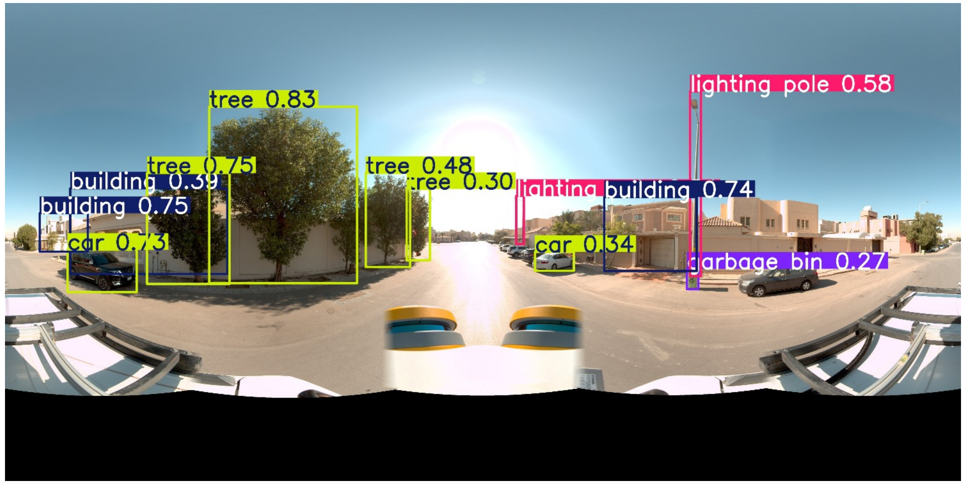
Model Training

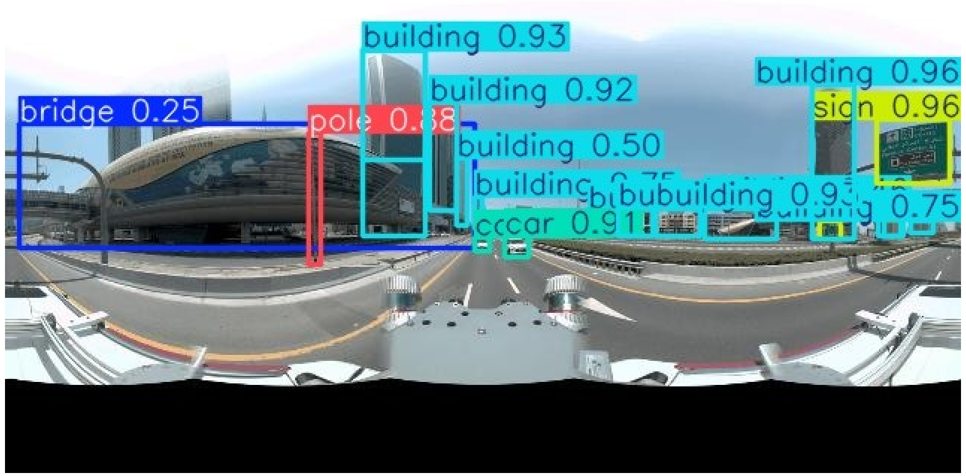
- For training the base-model a **custom dataset** consisting of spherical imagery captured on a base highway was used
- Data augmentation was implemented using
  i. Random noise and
  ii. Random blur
- Number of images: 1000 training images, 200 validation images, and 100 test images
- Object categories: 29 categories, including cars, traffic signs, curbs, etc.

Testing and Results

- Meta-learning was then performed using a number of samples per class (i.e. 10, 20, 30, 40 50).

- The model plateaued at around 30 samples per class.



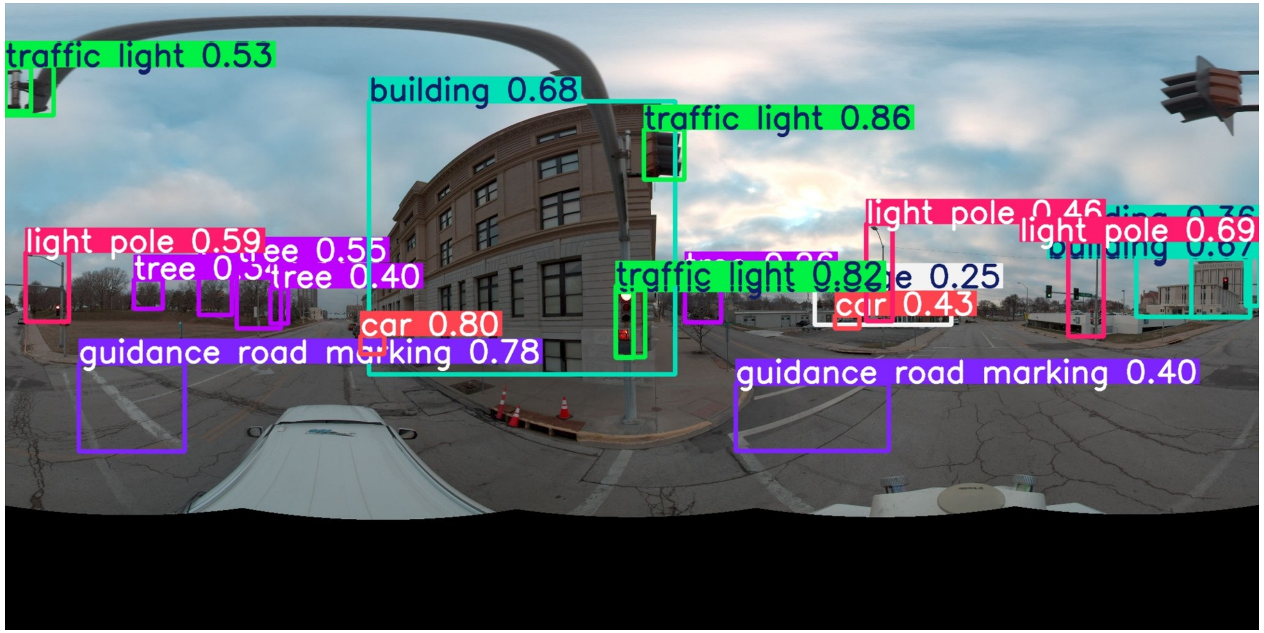


TESTING AND RESULTS

- The model was evaluated on spherical images from five different data sources and multiple class lists.
- Spherical data from three different cameras was used ladybug5, 5+ and 6 was used

RESULT COMPARISON

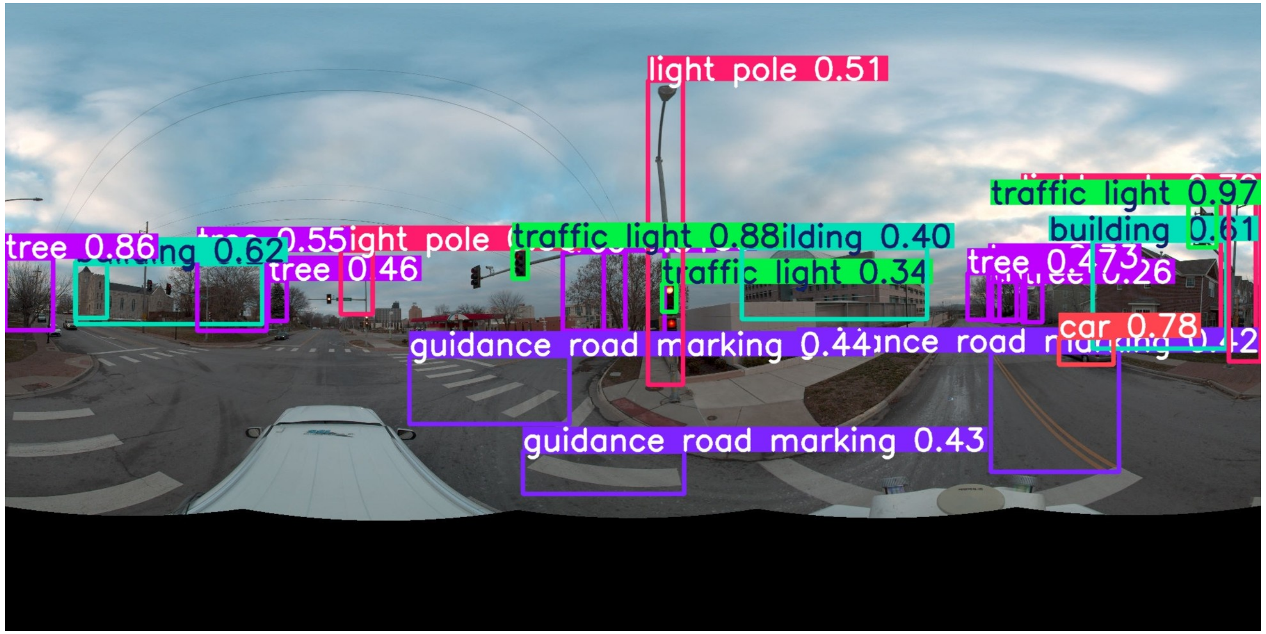
Output of Fine-tuned model



Output of Few-shot model

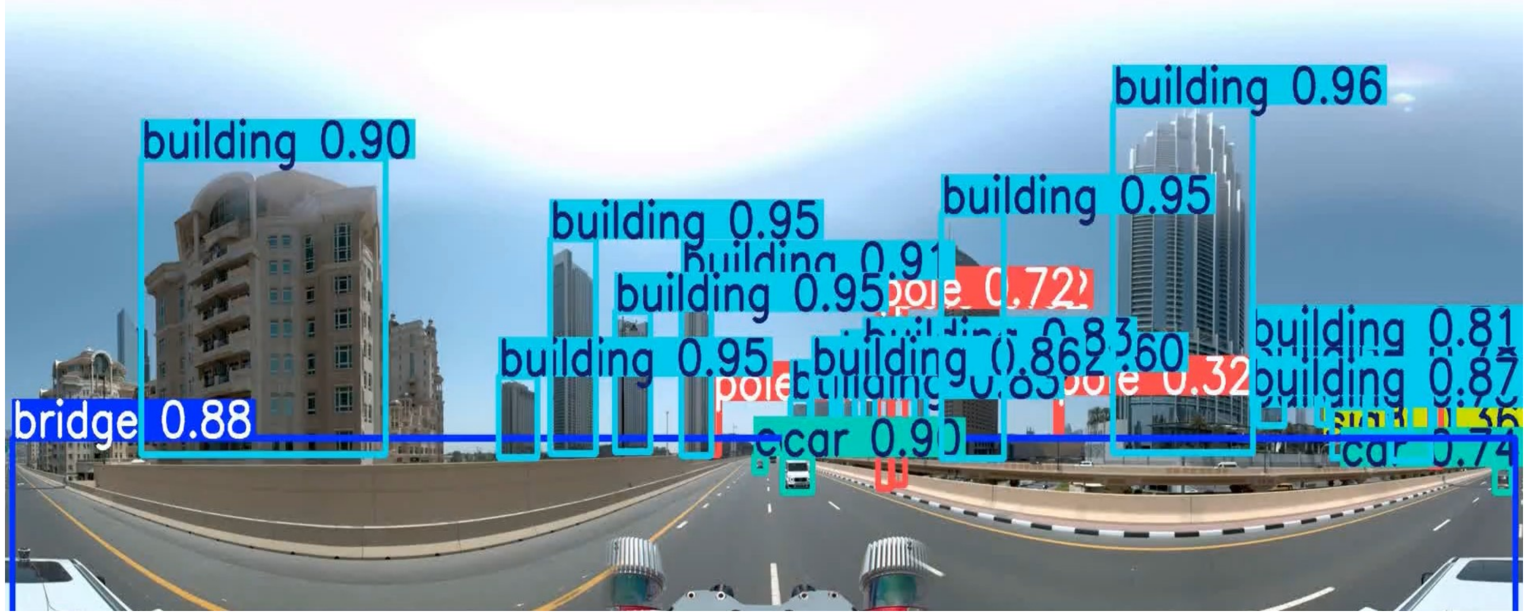
RESULT COMPARISON

Output of Fine-tuned model



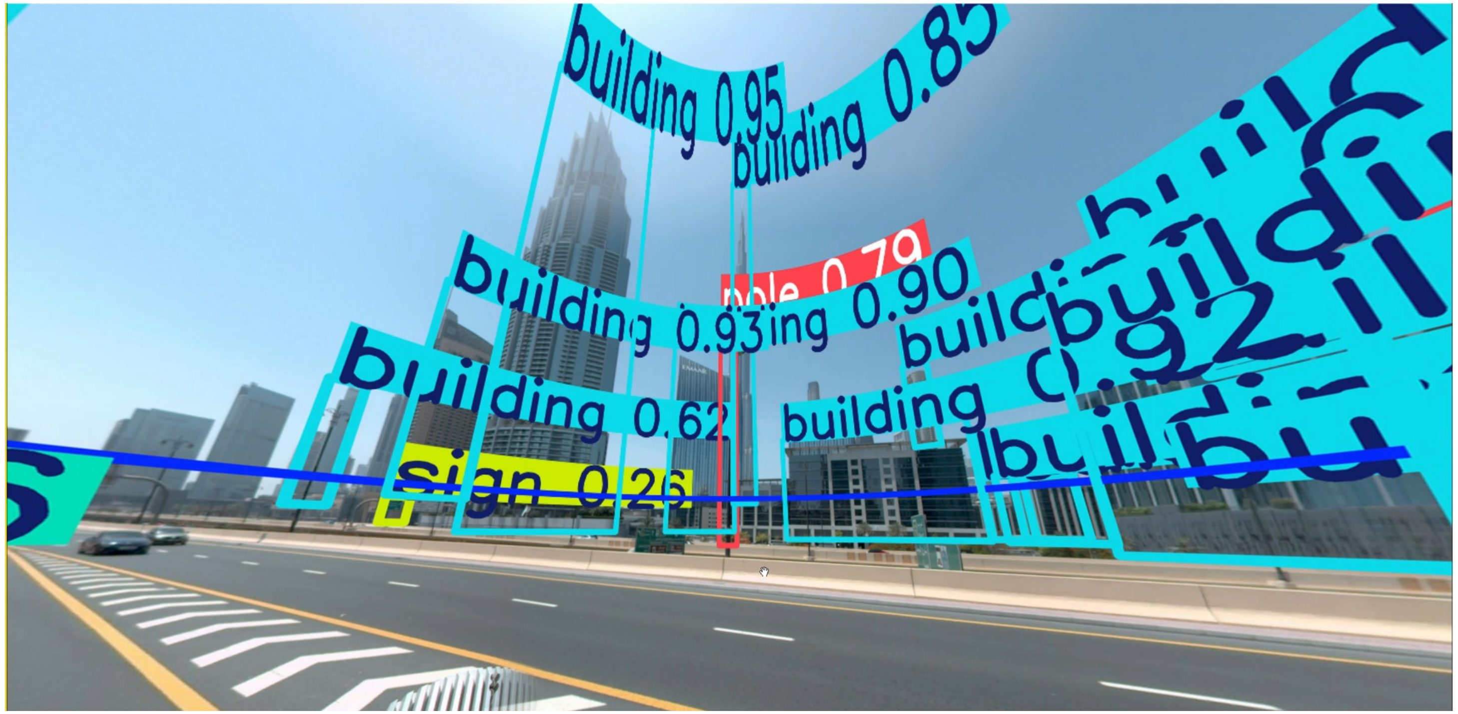
Output of Few-shot model

LARGE SCALE TESTING



Location: *UAE* Environment: *Suburban*

LARGE SCALE TESTING



Location: *UAE* Environment: *Suburban*

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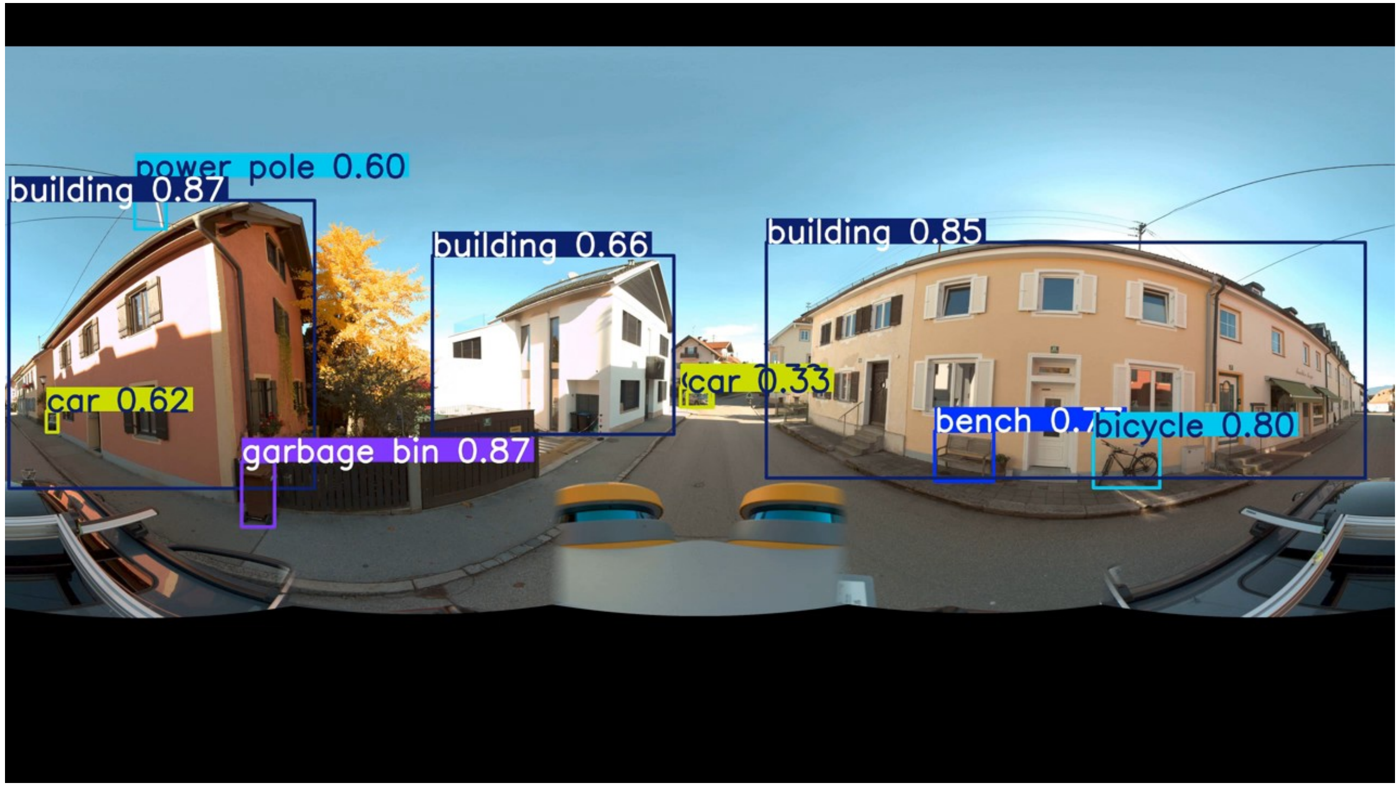
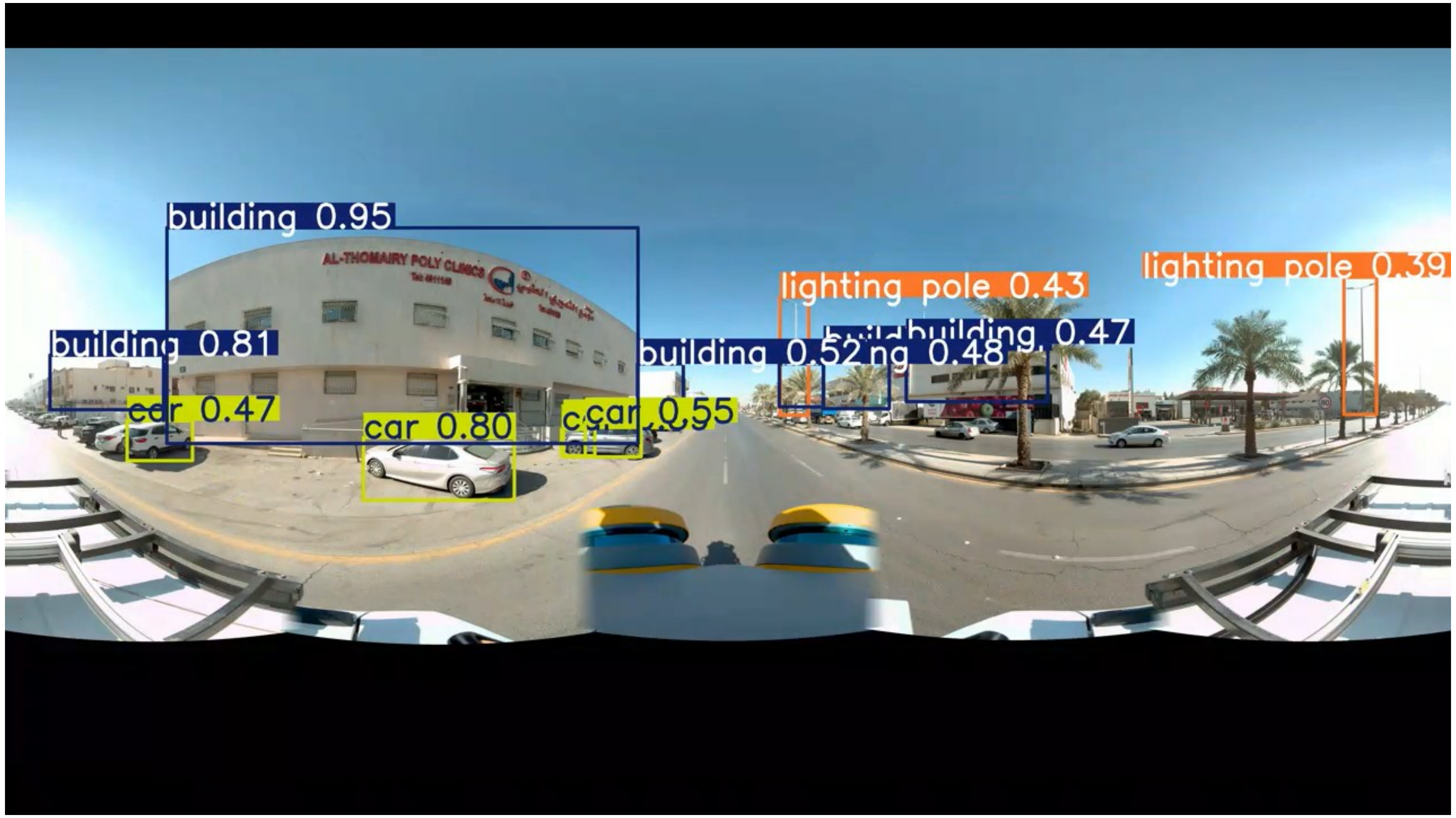
Large Scale Testing



Location: *Italy*

Environment: *Urban*

LARGE SCALE TESTING



Location: *Saudi Arabia* Environment: *Urban*

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LARGE SCALE TESTING

Location: *UAE*　　　　Environment: *Urban*

Summary and Conclusion

- The proposed approach helped achieve major gains with limited data.
- By simple learning how to learn, the model shifted from not being able to detect certain assets to being able to detect multiple different variations of the asset.

- The results demonstrated
  - More scalable, efficient, and robust road asset detection
  - Fast adaptability to new road asset classes
  - The findings help SME with limited access to training data to train more robust AI models.

References

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Questions ?

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