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CATAPULT Connected Places

HD MAPPING FOR AUTONOMOUS VEHICLES USING HIGH RESOLUTION AERIAL IMAGERIES

Session: **Incorporating Geospatial Technologies for Urban Mobility and Connectivity**

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Sponsored by Centre for Connected and Autonomous Vehicles, UKRI Innovate UK

AGENDA

16th May 2024

Who we are

Introduction to evolvAD

Project scope

Data and Methodology

Achieved Results

Next Steps

Further opportunities

Conclusions and Acknowledgement

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NISSAN

TRL HUMANISING AUTONOMY

SBD

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WHO WE ARE

Connected Places Catapult is the UK's innovation accelerator for cities, transport, and places providing 'innovation as a service' for public bodies, businesses, and infrastructure providers to catalyse step-change improvements in the way people live, work and travel.

CPC are in a unique position to undertake this work:

- By applying and building on learnings from previous research projects undertaken.
- GIS, demand modelling and CAV expertise all under one roof.
- Unlocking understanding around travel behaviour, people's perceptions and how that links to operation.
- Advancing Industry capability through dissemination.
- Helping to prove new methodologies to potential clients – informing updates of standards and guidance.

INTRODUCTION

evolvAD project aims to -

- Advance the UK supply chain by applying Autonomous Drive System technologies within urban residential roads and rural roads as demand for service.
- Target CAV development to enable vehicles to connect with end users across the UK.

Objectives of the Autonomous Vehicle map creation work -

- Develop an **affordable, scalable,** and robust AI model for extracting road infrastructure features.
- Bench testing to evaluate system performance and functionality.
- Simulator testing to simulate real-world scenarios and validate Autonomous Vehicles capabilities.

PROJECT SCOPE

Delivering a safe and securer drive on urban and rural roads. CAVs capable of driving in wide range of environments, to deliver scale to the sector

1. **CAV solutions deployed safely and securely at scale**
2. **Thriving UK supply chain**
3. **Export opportunity**

An informed supply chain, that is ready to deliver:

- In Use Monitoring
- Cybersecurity
- Safety case
- Software to improve VRU safety
- AV Map Creation
- Urban Residential AV
- Rural/Intercity AV

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DATA AND METHODOLOGY

Inputs

- 5 cm resolution aerial imagery from Bluesky
- 25 cm Master map imageries from Ordnance Survey, UK
- Information on road and surroundings from Ordnance Survey, UK

Methodology

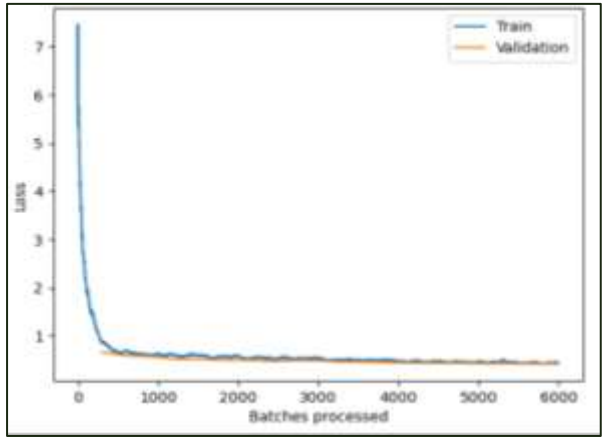
- Deep learning tools of ArcGIS Pro
- Instance segmentation or Mask R-CNN architecture.
- The ESRI deep learning tool is to train a deep learning model.
- Training of the model provides the average precision score (AP).
- TP: Number of true positives, FP: Number of false positives. FN: False Negative.
- The best value is 1 and the worst value is 0.
- Average Precision score definition: Precision averages across all recall values between 0 and 1.

Source: https://pro.arcgis.com/

For each class

$$Precision = \frac{Correct\ Predictions}{Total\ Predictions} = \frac{TP}{TP + FP}$$

Recall = (True Positive)/(True Positive + False Negative)



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ACHIEVED RESULTS

EDGE LINE DETECTION AND SPEED HUMP

- Training samples collected from urban residential areas of Central London
- 5 cm resolution imageries are used for the training
- Processing time to train: 1-7 hours (GPU)
- Processing time to detect: 20-30 mins (max)

Average precision score: 0.60

Average precision score: 0.88

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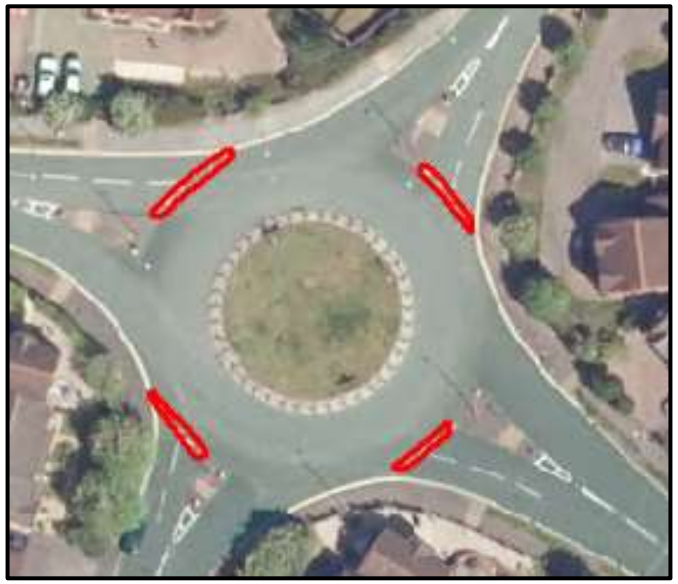
PEDESTRIAN CROSSING AND CYCLE STOP LINE

Average precision score: 0.85

Average precision score: 0.80

CENTRE LINE AND GIVE WAYS AT ROUNDABOUTS

Average Precision score: 0.68 (Improvement from the previous score of 0.61)



Average Precision score: 0.61

NEXT STEPS

- Fine-tuning hyperparameters
- Cycleways in urban areas
- Features specific to rural areas
- Mapping gradient changes along the road
- Model validation - partner vehicle testing via simulator in controlled environments.

FURTHER OPPORTUNITIES

- Exploring the adaptability of the solution across diverse ecosystems, ensuring its widespread applicability and effectiveness.
- Enhancing existing products or services by leveraging cutting-edge technology and innovative approaches.
- Exploiting the full potential of the solution as a customizable product, tailored to meet specific use cases and industry demands.

CONCLUSION

- The ArcGIS (ESRI) Deep learning model works best over a small area, however, in this case the model is applied to a large area, e.g., Central London, with promising results.
- The reported results so far are based on the outputs from the deep learning model. Further GIS analysis and modification will be done.
- Improve the model in terms of precision score and performance in further analysis.

ACKNOWLEDGEMENTS

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THANK YOU

Any Questions?

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