2025

AI Road Infrastructure Monitoring & Inspection

Demonstration Project: Infrastructure Inspection Platform

Innovator: ApoSys Technologies Inc.
Product: RoadSight AI
Demonstration Period: September 25 – November 5, 2025

Executive Summary

The City of Vaughan is advancing next-generation solutions to address real-world mobility and transportation challenges.

Through the Ontario Vehicle Innovation Network (OVIN) Demonstration Zone, ApoSys Technologies is testing an AI-powered road infrastructure monitoring solution in a live municipal environment. The demonstration aimed to validate the feasibility and the opportunity for operational improvements of computer vision and machine learning for automated road asset management.

The OVIN Demonstration Zone is an initiative that is part of Vaughan's Transportation Innovation Program (TIP), which aims to test smart mobility and connected transportation solutions in real-world environments. This demonstration was completed in partnership with **Vaughan's Infrastructure Planning and Corporate Asset Management and Transportation and Fleet Management Services (MoveSmart, Traffic Engineering)** teams.

The Innovator

ApoSys Technologies Inc. (ApoSys) is a Mississauga-based infrastructure intelligence company operating for ten years. The company specializes in advanced sensing and analytics for transportation networks, delivering solutions that integrate Artificial Intelligence (AI), computer vision, and Geographic Information System (GIS) technologies. ApoSys focuses on automating roadway asset inspection to improve safety, optimize maintenance, and reduce operational costs.

Demonstration Overview

The demonstration focused on automating the detection, classification, and condition assessment of select roadway assets that are maintained by the City of Vaughan, such as traffic signs and pavement markings. Data was collected using video data captured from a vehicle-mounted camera driving at traffic speed. The solution also evaluated key metrics such as visibility distances for traffic signs, supporting safety and compliance assessments. This initiative aligns with Vaughan's objectives to create resilient transportation infrastructure, maximize value from existing assets, and leverage data for informed decision-making.

The camera hardware was tested in August 2025, and then ApoSys' team began the first phase of the project, which required training their AI-powered computer learning system on images and references for the specific road assets of the test site. This took 45 days to train for accuracy. This learning phase is required for new types of data, as ApoSys tailored the capture include road signs and road assets that were unique to the test site.

The demonstration video capture was then completed on September 25, 2025. The camera was mounted to the passenger side of the capture vehicle. It took **16 minutes and 28 seconds** to drive along both sides of the test site's **5.1 km road segment (10.2 km total)** at King Vaughan Road/Cold Creek Road between Albion Vaughan Road and Nashville Road. The test day featured variable lighting conditions and light rain.

ApoSys successfully showcased its ability to deliver actionable insights through automated workflows, reducing reliance on manual inspections and enabling proactive maintenance planning.

Key Outcomes

- RoadSight AI trained its system to **detect specific road signs** for the test site's road segment
    - **20 unique types of road signs with geolocation tags** were in the project inventory
    - **Two signs were detected** with visibility obstruction from vegetation
- **Pavement markings and surfaces conditions of road across 5.1 kilometers** were inspected for:
    - **Pavement Marking Condition**: markings were evaluated for visibility by ApoSys' Pavement Condition Index (PCI) – rated on a scale of 1-5.

        This proprietary index describes the visual condition to show wear of the asset – outside of regulatory standards.
    - **Pavement Road Surface Deficiencies**: pavement and road surface was inspected for eight types of cracks, holes, and patches – including characterizing them as longitudinal or latitudinal (where applicable).

<u>Opportunity Areas</u>

The demonstration provided insights to key opportunity areas:

- **Proof of Concept Validated** – RoadSight AI successfully processed the video capture to classify three types of road assets under the demonstration criteria: road signs, pavement marking, and pavement and road surface deficiencies. This validated the system's end-to-end workflow – from video ingestion to GIS-ready outputs.
- **Operational Efficiency** – RoadSight AI successfully autonomously detected and classified multiple types of road assets. Manual collection of the video recording time remained the same and did not require additional staff resources to capture the assets – showing potential for RoadSight to scale the inspection stages of the process.
- **Data Quality and Accuracy** - Overall accuracy of asset location and classification was high, with minor rework required to adjust system accuracy (e.g., one of twenty unique sign types required sensitivity adjustment to improve accuracy).
    - Pavement marking data required reformatting for GIS integration, but proved usable.
    - The captured footage was in 4k resolution and detected assets with tracked geolocation tags.

- **Weather Resilience and Stress-Testing** – The hardware (camera) maintained performance under wet conditions. The RoadSight AI system was able to successfully process the data capture with these conditions.

Economic Impact

- One new job was created to support the development for the project: a Senior Mechanical Engineer.
- One prototype successfully launched, with a roadmap for product rollout implemented.

Key Findings:

- **Vehicle-Mounted Camera Effectiveness**: The camera successfully captured footage at a high enough resolution to provide accurate data to perform AI analysis.
- **Accuracy and Functionality:** RoadSight AI reliably identified and classified roadway signs and pavement markings, including visibility assessments. Pavement distress detection was effective for cracks, patches, and potholes, though depth measurement and PCI scoring were not included.
- **Operational Efficiency:** Automated data collection and processing significantly reduced manual effort during the asset's inspection, indicating potential cost savings and improved resource allocation.
- **Resilience:** The system maintained performance under variable weather conditions, reinforcing its suitability for real-world deployment.
- **Areas for Improvement:** The learning phase may require more time or testing at intersections to calibrate the sensitivity of sign detection. Further development for the calibration of the Pavement Condition Index is recommended to address nighttime visibility and retroreflectivity for visibility accuracy. Additionally, further development of surface-deficiency depth measurements is recommended to enhance the system's features to increase metrics for standards compliance.

Exclusions

Demonstration projects through the OVIN Demonstration Zone are temporary and limited in scope and duration due to the time constraints of the OVIN Demonstration Zone program. The project evaluated key features of ApoSys Technologies' solution, as determined by the Project Advisory Team.

It should be noted that illumination and signal poles were not included in the scope of work. ApoSys also has its Apollo dashboard – for data reporting, where system recommendations can be integrated into municipal workflows and assets can be displayed through a map interface, however this was also not included in scope of the project – primarily due to time constraints.

Obstacles

Obstacles encountered that may have had an impact on the overall results of this demonstration project are as follows:

- Additional time for the project may have allowed ApoSys to demonstrate its Apollo dashboard that can display the results of the data capture on a map-based display.
- Additional time would also have allowed the project team to perform data capture at night and in more inclement weather to determine the impacts and better train the AI system.

Conclusions and Recommendations

ApoSys' RoadSight AI demonstration successfully validated the technical feasibility and potential of using AI-driven solutions for roadway asset inspection. The system demonstrated strong capabilities in detecting and classifying traffic signs, pavement markings, and pavement surface conditions, while providing georeferenced outputs suitable for integration into municipal workflows. Their Pavement Condition Index provided additional visibility indicators.

While RoadSight AI demonstrated strong potential for automating roadway asset condition assessments, its proprietary condition index requires further validation against municipal standards. To ensure compatibility and reliability before the consideration of municipal operational use, the following steps are recommended:

- **Field Verification:** Conduct comparative analysis between RoadSight AI's condition ratings and the City's established Pavement Condition Index (PCI) methodology through on-site inspections.
- **Nighttime Testing:** Expand demonstrations to include nighttime conditions to evaluate retroreflectivity of pavement markings and sign visibility. This will ensure the system can accurately identify assets that meet stopping sight distance requirements and detect degraded retroreflective surfaces.
- **Performance Metrics:** Define clear metrics for condition rating accuracy, including variance thresholds compared to standard PCI scores, to guide future adoption decisions.
- **Larger Tests and Evaluations:** Conduct more robust testing with larger sample sizes and clearer controls to help potential users build confidence in how the system supports targeted asset management

The system captured pavement abnormalities and identified the locations as well as successfully classified defects such as block cracks, longitudinal cracks, transverse cracks, patches or potholes. The next step would be to manually review the roadway surface to compare the results with RoadSight. This would help to better calibrate the AI video analysis.

Additional demonstration projects could compare collected data with existing inventories and field reviews to determine actual accuracy of asset locations and conditions. Collecting of sign and pavement marking visibility at night would help assess retroreflectivity for replacement purposes. This will confirm system accuracy and support further machine-learning calibration to increase overall effectiveness.

Overall the ApoSys system performed well and has real potential as a tool in pre-screening assets like signs, markings and pavements for a more focused detailed analysis and with enough development could progress to a full screening tool for these assets.

Demonstration Zone Project Profiles: http://www.vaughanbusiness.ca/demozone/projects