🗓 START – FINISH	💲 COST	👥 PARTNERS
December 2023 – June 2024	$95,000	• HDR • MnDOT Asset Management • MnDOT Traffic Engineering

Project Description

This project investigated the use of evolving machine vision technologies to improve asset management procedures. Machine vision is technology that enables machines to "see" and interpret images, similar to how humans see and understand the world. It includes capturing an image, analyzing the image, and then completing and action or decision based on the analysis.

The team explored currently available commercial products and open-source academic algorithms and approaches, with a focus on approaches that allow the use of imagery that MnDOT already collects—such as the pavement management VideoLog and snowplow dash cameras. There were three key objectives:

1. **Evaluate automated technologies** to enhance the efficiency and accuracy of existing road asset management systems.
2. **Investigate advanced lane line detection methods** to support MnDOT's transition to connected and automated vehicles (CAVs), ensuring system safety and operational reliability.
3. **Design condition metrics and a scoring framework** for assessing the state of movement markings using image-based data.

Project Goals

The following goals align with the state's broader CAV program goals. Reference page 18 of the Strategic Plan for full descriptions of the seven CAV program goals.

Program goal	Project goal
⊙ Efficiency	Understand how we can assess asset condition statewide without manual inspections.
⊙ Readiness	Assess feasibility of a metric for pavement marking compatibility for automated vehicles.

Figure 1. Illustration of machine vision detecting roadside assets, such as traffic signs.

Project Accomplishments

- Identified several commercial and academic solutions to use machine vision for asset management uses
- Compared potential commercial solutions
- Tested pavement marking assessment using open-source solutions and VideoLog data
- Validated feasibility of using existing VideoLog data to measure pavement marking condition at a statewide level

Project Key Findings

Commercial video analytics solutions

Several companies are currently offering video analytics solutions for transportation asset management uses. The majority of the solutions identified focus on the use of data they collect or use of their own proprietary video collection equipment. Many of the solutions focus heavily on pavement condition, but this study focused mostly non-pavement assets including traffic signs, traffic lights, concrete barriers, etc. At the time of the study most commercial solutions used a per mile cost, providing a one-time assessment. Based on the costs the team found during the study it would not be reasonable to monitor

condition system wide continuously using the commercial solutions identified at the time of the study.

Feasibility of VideoLog images for assessing pavement marking condition

The team successfully tested three different lane detection systems (Vaisala RoadAI, Blyncsy Payver, and Enlite AI Detekt) using a random sample of MnDOT VideoLog data. The algorithms tested were designed for lane detection in support of driving automation systems. However, since the visibility of the marking is central to their function, it also serves as a key indicator of their condition. This demonstrated that a system could be developed to automatically score pavement marking condition automatically using VideoLog data, effectively flagging locations needing additional inspection. System-wide screening is not currently feasible with the existing pavement marking inspection systems and staffing levels. Results from this study indicate the three software solutions are viable options for automating and improving MnDOT's road asset management practices.

Recommendations for implementation

Short term focus:

- Data capability and processing
- Flexibility in data collection methods
- Retro-reflectivity analysis
- Reporting capabilities
- Field reporting features
- Pilot project suitability

Long-term vision:

- Advanced capabilities
- Scalability and adaptability
- Integration with broader infrastructure ecosystem
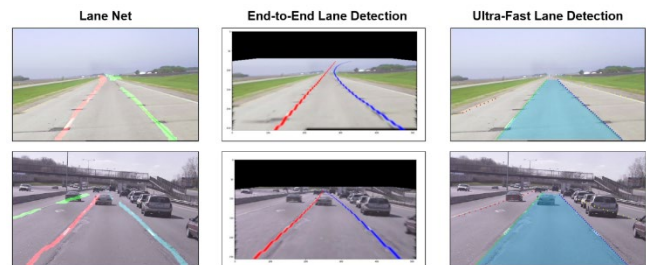- Proven track record and commitment to US market

Figure 1. Test results on MnDOT dataset, general detection comparison between algorithms.

🔎 Lessons learned

- Machine vision solutions exist and can be developed to screen asset condition
- Many commercial solutions require specific or proprietary cameras
- Existing image and video data can be used to assess assets using machine vision systems

➜ Potential next steps for MnDOT

- Identify priorities for pilot deployments
- Determine how solutions machine vision solutions may integrate with MnDOT processes and systems
- Develop pilot deployments

For more information on this project, please contact **MnDOTCAV.DOT@state.mn.us**

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