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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

# Research Notes

# Development of Specifications for Computer Vision Platforms for Caltrans' CCTV Cameras

This project focuses on enhancing traffic movement detection by developing specifications and requirements for deploying computer vision platforms that connect with Caltrans' existing network of CCTV cameras of different types.

**Traffic Operations**

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**Project Title:**
Connected and Automated Vehicle Cross Cutting Research

**Task Number:** 4337

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## WHAT IS THE NEED?

A key challenge in improving roadway safety and mobility is a lack of data. Prevailing methods for detecting traffic movements and assessing safety and performance typically rely on loop detectors and pedestrian push buttons. Although video cameras have been installed at some intersections, they are typically used either for surveillance purposes or with very limited detection functionalities, such as acting as virtual detectors for actuated traffic control in replacement of loop detectors. These systems often struggle with detecting multimodal traffic comprised of cars, trucks, bikes, and pedestrians, in addition to failing to identify movements beyond pre-set limited detection zones.

A lack of detailed connected infrastructure data also hinders the deployment of connected and automated vehicles (CAVs). For example, while the California Connected Vehicle (CV) Testbed already has Vehicle-to-Everything (V2X) communications capabilities, its V2X promise has yet to be fully realized due to sensing limitations. For instance, it is not very helpful to broadcast the activation of pedestrian phases to notify nearby connected road users as the activation of a pedestrian phase doesn't necessarily mean there are pedestrians or bicyclists on the related intersection crosswalks.

As a result of rapid development in sensing technologies, computing devices, and algorithms, there are now advanced computer vision solutions available that can detect, track, and classify multimodal traffic within the field of view of cameras. Since Caltrans is operating over 3000 CCTVs on the state highway system, these new technologies offer huge potential to leverage the existing infrastructure to improve current traffic monitoring and management practices

Caltrans

DRISI provides solutions and knowledge that improves California's transportation system.

through the deployment of computer vision solutions connected to Caltrans' CCTV cameras.

However, due to the complexity of camera specifications (e.g., resolution and framerate) and when and where these cameras were installed, there is a lack of guidelines within Caltrans to support decisions on piloting computer vision platforms linked to its CCTV cameras. A lot of questions still need to be addressed: for example, what information can be extracted from existing CCTV video streams using computer vision technologies, what use cases can be supported, what hardware and communication support is needed, what data processing approach would be suitable, what elements should be included in a data management plan, what maintenance costs would be, and what requirements would be for security, privacy, and legal compliance.

## WHAT ARE WE DOING?

The project will establish a set of rules to classify Caltrans' existing 3,000+ CCTV cameras based on resolutions, framerates, installation locations, and capabilities to determine their suitability for computer vision applications. Both commercially available and open-source computer vision platforms will be assessed to evaluate their capability and accuracy in detecting, tracking and classifying multimodal traffic including passenger cars, trucks, buses, bicycles, pedestrians, scooters, etc., as well as their data analytics speed and data management requirements. The outcome of this assessment will provide Caltrans with a set of specifications and requirements to guide procurement and future deployments of computer vision platforms integrated with its CCTV network, ensuring improved traffic monitoring, safety, and mobility.

The developed specifications and guidance will be documented in a Word-based specification document, and an interactive Excel spreadsheet tool, allowing users to view target specifications through menu-driven options. The project will conclude with the delivery of a final report summarizing all project activities and findings, along with the execution of a knowledge transfer workshop to ensure effective implementation and adoption of the developed specifications.

## WHAT IS OUR GOAL?

This project's goal is to address the challenges of ineffective existing methods of detecting traffic movements by developing specifications and requirements to support the deployment of computer vision platforms linked to Caltrans' existing network of CCTV cameras of different types.

## WHAT IS THE BENEFIT?

The outcomes from this research project provide Caltrans with useful insights into how computer vision platforms can be used to leverage existing cameras owned by the agency to support better traffic monitoring and management. It will help Caltrans: (i) envision the deployment needs for future statewide pilots of advanced sensing technologies; (ii) make informed decisions on purchasing new CCTV cameras; and (iii) maximize the usefulness of existing cameras installed on the state highway system, prolong their lifespan, and reduce operational costs by replacing cameras only when truly necessary, such as in the case of hardware failure.

## WHAT IS THE PROGRESS TO DATE?

The kickoff meeting took place on October 22, 2025. Since the contract was executed several months later than the planned start date, we are in the process of submitting a no-cost time extension for this contract.