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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Guidance on Road Side Units Placement for Future Deployment of Connected and Automated Vehicle Applications

Planning tool to provide California Depatment of Transportation District Engineers guidance on road side units placement for Connected and Automated Vehicle Applications

Advanced Research

MAY 2024

Project Title:
Guidance on Road Side Units Placement for Future Deployment of Connected and Automated Vehicle Applications

Task Number: 4081

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Completion Date: May 31, 2025

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WHAT IS THE NEED?

To facilitate future deployment of Connected and Automated Vehicle (CAV) applications, it is critical to upgrade existing road infrastructure with road side units (RSU) to enable Vehicle-to-Everything (V2X) communications for various CAV applications. When a freeway or an arterial network is selected, the current approach, like in the California Connected Vehicle Testbed, is to install RSUs at all road intersections. However, this approach is not cost-effective for network-level deployment due to limited budgets to install and maintain RSU facilities and low penetration rates of CAVs on surface roads. Therefore, it is crucial to develop a generalized tool that can guide California Department of Transportation (Caltrans) District Engineers at the planning stage to pick the right locations to install RSUs for selected CAV applications with cost effectiveness.

WHAT ARE WE DOING?

This task will take care of the following activities.

1. Conduct a literature review on existing CAV applications. Generate a list of CAV applications to be implemented in this project in consultation with the project panel.
2. Implement the selected CAV applications in the integrate microsimulation platform in the Aimsun program.
3. Generate subnetworks, networks and design simulation scenarios from the I-210 corridor in consultation with the project panel.
4. Conduct simulations, summarize simulation results, and develop the sketch-level planning tool.
5. Document all findings in a final report and provide a workshop to Caltrans engineers on how to use the sketch-level planning tool.

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WHAT IS OUR GOAL?

The end goal of this task is to have a fully functional planning tool to provide Caltrans Districts Engineers guidance on RSU placement for CAV applications.

WHAT IS THE BENEFIT?

The sketch-level planning tool can help Caltrans Engineers identify the best locations in a targeted project area to install RSUs to achieve desired performance for selected CAV applications. In the long run, this sketch-level planning tool can be further enhanced with more CAV applications, more test networks and scenarios, and more interactive features to provide Caltrans better guidance on the installation of RSUs at the network scale.

WHAT IS THE PROGRESS TO DATE?

Progress 1/1/2024 – 3/31/2024

Task 1: Project Management

- The project team had a progress update meeting with the Caltrans project manager and Caltrans Traffic Ops staff on March 18, 2024.

Task 2: Technical memo: literature review and a prioritized list of CV/CAV applications

- The project team submitted the technical memo for Task 2 on November 13th, 2023.

Task 3: Technical memo: subnetworks and scenario design

- The project team has reached out to Aimsun to fix several bugs in the V2X module. According to the Aimsun Technical Support, we are able to model pedestrian activities. However, we are not able to assign OBUs to them to enable connectivity. We are in the process to identify whether the simulated vehicles in Aimsun can identify the pedestrians when they are on crosswalks.
- Also, for the modeling of cyclists in Aimsun, we are able to assign OBUs to them to enable connectivity. We are also able to control the movements of cyclists to support the safety warnings to avoid potential collisions.
- The project team has implemented the architecture for the application of Curve Speed Warning and showed it to Caltrans during the project progress meeting on March 18.
- The project team has been working on the architectures for the following applications: (i) Intersection Safety Warning and Collision Avoidance; (ii) Queue Warning; (iii) Speed Harmonization.

Task 4: Technical memo: subnetworks and scenario design

- The project team has been working on the generation of test networks for the applications: (i) Intersection Safety Warning and Collision Avoidance; (ii) Queue Warning; (iii) Speed Harmonization.

Task 5: Technical memo: summary of simulation results

- The project team has begun the simulation for the application of Curve Speed Warning and started to analyze the results.