Advanced Research

MAY 2024

Project Title:
Connected and Automated Vehicle (CAV) Application Development

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Connected Vehicle Application Development (CVAD)

A study focuses on improving tools to better develop and implement connect vehicle applications to benefit the public, environment, and economy of California.

WHAT WAS THE NEED?

In the past, the United States Department of Transportation provided financial and technical support to California Department of Transportation (Caltrans) test bed site in Palo Alto, CA, for the development of the dedicated short-range communication infrastructure.

At that time, the test bed site was fully operational and comprised 11 intersections. Caltrans was in the process of preparing for the deployment of at least 20 connected vehicle (CV) upgraded intersections on highway 82 to meet the Signal Phase and Timing (SPaT) challenge by January 2020. Since many CV applications necessitate longer CV-equipped corridors for proper functionality, expanding the number of intersections from 11 to 31 at the test bed site would offer a better environment for application developers to conduct testing and development of both vehicle and infrastructure components.

WHAT WAS OUR GOAL?

The objective of this research was to achieve a fully functional test bed with 31 intersections, enabling various private and public entities to develop CV applications.

WHAT DID WE DO?

This research involved the following tasks:
1. Expanded the California CV test bed to meet the requirements of the National Operations Center of Excellence for the SPaT challenge.
2. Developed, implemented, and conducted field tests for a set

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

of CV applications to establish technological foundations for the deployment of CV systems in California

3. Supported the deployment of CV in California

WHAT WAS THE OUTCOME?

Under this Contract, five (5) Dedicated Short Range Communications (DSRC) intersections were added to the El Camino Real (ECR) test bed, expanding the total number of DSRC intersections to sixteen within a 3-mile stretch on the ECR. These DSRC intersections became operational in November 2019 but ceased operations in November 2022 due to the Federal Communications Commission (FCC) ruling on the use of the 5.9 GHz band.

In the second phase of expansion, fifteen (15) Cellular Vehicle-to-Everything (C-V2X) Roadside Units (RSUs) were incorporated into the ECR test bed, resulting in a total of thirty-one intersections spanning a 7-mile stretch on the ECR. These C-V2X intersections will be activated once FCC experimental licenses are obtained.

A successful field demonstration of CV-based Transit Signal Priority (TSP) was conducted in August 2020, utilizing a Santa Clara Valley Transportation Authority (VTA) bus equipped with a DSRC On-Board Unit (OBU). Additionally, a range of CV applications, such as lane closed ahead warning, reduced speed ahead warning, pedestrian crosswalk ahead warning, lane merge ahead warning, and watching out for opposite traffic warning, were developed, and tested within the ECR test bed. These developments served as crucial technological foundations for the deployment of CV systems in California.

WHAT IS THE BENEFIT?

The improved test bed provides a platform for software engineers to develop various CV transportation applications that improve the throughput and safety for vehicular movements on highways, arterial, and surface streets. This ultimately helps drivers in cutting travel times, saving fuel, and improving safety.
Caltrans is the primary beneficiary as the developed applications increase efficiency in managing traffic flows and reducing the carbon footprint.

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TBD-Final report link.