FTA RESEARCH
FEDERAL TRANSIT ADMINISTRATION

REPORT SUMMARY

U.S. Department of Transportation
Federal Transit Administration

Vehicle Assist and Automation Demonstration Report

Background

In 2008, the California Department of Transportation (Caltrans) was awarded $1.9 million by the Federal Transit Administration (FTA) and the Intelligent Transportation Systems Joint Program Office (ITS JPO) for a pilot program to demonstrate the benefits of vehicle assist and automation (VAA) applications for full-size public transit buses; Caltrans provided a $1.5 million match. Caltrans' partners included Alameda-Contra Costa County Transit District (AC Transit) in California, Lane Transit District (LTD) in Oregon, Partners for Advanced Transportation Technology (PATH) at the University of California–Berkeley, and three private sector companies.

Objective

The objective of the project was to demonstrate the technical merits and feasibility of VAA applications in bus revenue service.

Findings and Conclusions

Data from revenue service operations consistently demonstrated that the VAA system achieved superior performance over manual driving; for lane-keeping, the lateral deviation achieved by the VAA system had a standard deviation less than half of that achieved by manual steering.

A VAA system provides automated steering or driver assistance functions to help maintain a transit vehicle in a designated lane or a desired trajectory. VAA systems can be used in applications such as precision docking, lane guidance, lane-keeping or lane-changing, and longitudinal control.

This VAA project was one of the first vehicle automation projects that dealt with many real-world deployment issues, including substantial new development of hardware and software for improved reliability and safety; development process for product-like components and subsystems to meet the requirements of revenue services; deployment issues such as project delivery, as well as infrastructure, maintenance, and operational preparation; close collaboration with transit agencies and bus operators during the development phase; application and assessment of real-world operational scenarios; and complexities in contractual arrangements with transit agencies and multiple industrial partners.

This project was carried out through the four phases of design, development, deployment, and operational tests. In the design phase, the system architecture and requirements were finalized, and test plans were generated for

four levels of testing. All hardware and software components were developed in the development phase, and test buses were instrumented. In the deployment phase, a 60-ft articulated bus was equipped, and system performance and reliability testing were conducted first at a test track and then on an operational route in Eugene, Oregon. After operational testing without passengers, revenue service at Lane Transit District (LTD) commenced. Data from revenue service operations showed that the VAA system met its performance goals, specifically that lateral deviation was substantially smaller under automated operations than it was under manual driving. Note: Numerous contractual issues and delays resulted in AC Transit dropping out of the project.

Transit agencies considering deployment of VAA should consider the following major factors:

1. There must be a need for deploying a specific VAA application. For example, LTD needed precision docking for its EmX BRT system to provide consistent bus alignment during stops at stations to reduce driver stress and to eliminate damage to buses and station platforms from collisions that occurred occasionally during manual docking maneuvers. VAA was able to address this need.
2. Sufficient resources must be available to develop and deploy such a system, both financially and in the way of support from management and decision-makers. In the case of the VAA demonstration project, funding and continued support from FTA and Caltrans were the key for success.
3. The technology needs to be available and a team ready to deliver it. In this project, PATH had almost 20 years of practical experience in vehicle automation and control systems.
4. The customer must be willing to provide its operational experience, facilities for testing, and support for deploying such a system. The support from LTD was critical to the successful deployment of the VAA system in revenue service operations and provided the real-world experience and feedback that bridged the gap between a prototype system and deployment-ready system for revenue service operations.
5. It is critical to adopt safety standards in the design, development, and deployment process of a bus VAA system to ensure that the system is as safe as possible. ISO 26262 is a widely-accepted international automotive functional safety standard that defines functional safety for all activities during the lifecycle of safety-related systems comprising electrical, electronic, and software components.

Benefits

The unanimous response from all local project partners was that the VAA demonstration was a success and proved that VAA technology can work successfully in bus revenue service. The precision docking was recognized as the most successful element of the demonstration; bus operators regarded it as a valuable tool for safe and effective docking and for lowering operator stress when docking.

Project Information

FTA Report No. 0113

This research project was conducted by the California Department of Transportation (Caltrans) and Partners for Advanced Transportation Technology (PATH) at the University of California–Berkeley. For more information, contact FTA Project Manager Steve Mortensen at (202) 493-0459, steven.mortensen@dot.gov. All research reports can be found at **https://www.transit.dot.gov/about/research-innovation**.