LeddarTech®
SOLVING CRITICAL SENSING, FUSION AND PERCEPTION CHALLENGES

Case Study

Transit Bus Collision Avoidance System Protects Vulnerable Road Users With Flash LiDARs

1. The Challenge

Transit buses operate in environments with a high density of vulnerable road users (VRUs). Accidents involving transit buses and VRUs are an ongoing recurrence worldwide and represent a significant concern in the North American market, where they generate countless injuries and fatalities and result in billions of dollars in casualty and liability expenses.

In urban environments, transit bus drivers must deal with an array of factors competing for their attention. Human response is not instantaneous, as an unaware operator typically takes 1 second to respond when confronted with a problematic situation.

Passive pedestrian collision warning systems are available to support drivers. They provide visual and audible warnings, like beeps and flashing lights, when a risk of collision is detected. These warnings, however, compete for drivers' attention in a complex environment with traffic, passengers, vehicle noise and other distractions. And every fraction of a second lost in driver reaction time to an impending collision is critical.

DCS Technologies was aiming to develop a better solution that would automatically decelerate a vehicle when an imminent VRU collision is detected. The system would increase the safety of VRUs by eliminating or reducing the severity of incidents between transit buses and VRUs. This system should:

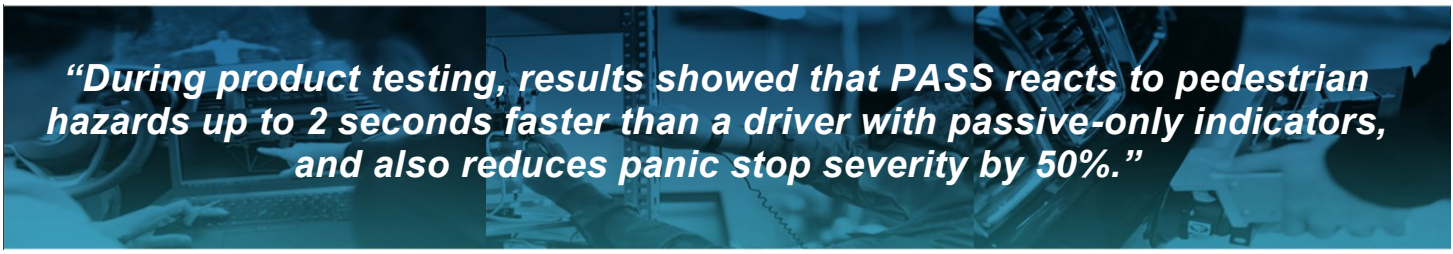
a) Mitigate collisions with vulnerable road users
b) Protect unrestrained/standing passengers inside the vehicle
c) Provide *operator assistance*, not *operator replacement*

System Requirements

The DCS system aims to offer “constant vigilance” by providing object detection and tracking, informing the driver and initiating an active response via an automatic deceleration feature.

Automatic deceleration helps drivers avoid or reduce the severity of a collision with pedestrians and bicyclists while protecting passengers by applying a controlled amount of deceleration to the vehicle when an imminent collision is detected, giving drivers more time and distance to react.

The sensing solution involved had to meet two key criteria. First, the sensor should provide reliable, accurate and repeatable detection/distance measurement of VRUs. Second, the sensor should be robust and durable, as transit vehicles operate year-round in a very harsh environment (vibration, shocks, temperature, humidity, etc.).



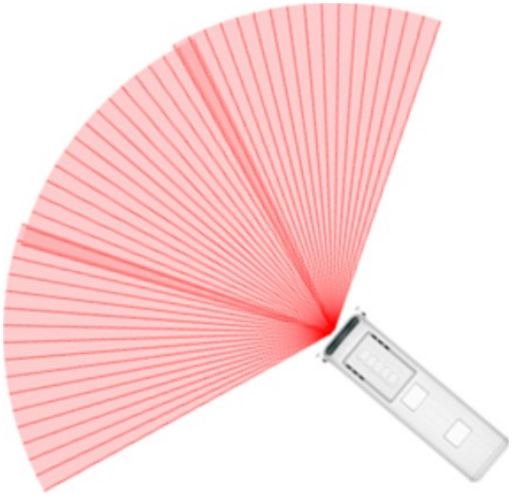
2. The Solution

PASS™ CAWS (collision avoidance warning system) and AEB (automatic emergency braking) system is designed to assist transit operators in avoiding and/or reducing the severity of pedestrian and vehicle collisions, without introducing risk to passengers. PASS determines–within a fraction of a second–if an automatic action is required. The system detects and tracks objects, determines if a collision scenario is present, provides the operator visual and audio feedback and, if necessary, activates PASS automated emergency braking (AEB) function based on proprietary algorithms. The system is fully J1939 compliant and is powered from existing 12V/24V vehicle battery voltages.

PASS’ CAWS and AEB functions can be configured without hardware or software modifications using deceleration feature selections and filtering across a wide range of vehicle platforms, route characteristics and transit agency preferences and requirements.

PASS Pedestrian Avoidance Safety System

During initial product performance scoping for its PASS system, DCS considered typical object detection sensor technologies. However, cameras cannot provide direct distance measurement, ultrasonics have a low detection range and radars deliver inconsistent measurement performance of pedestrians.

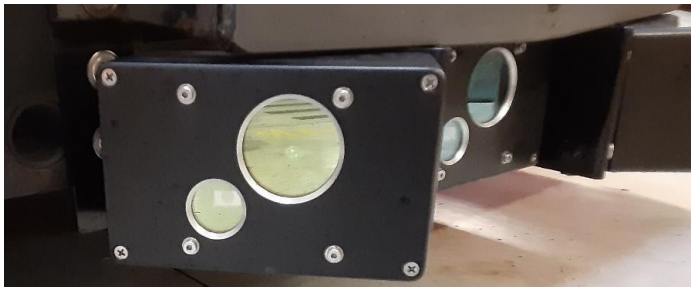


While the initial PASS product was designed with inputs from a third-party collision avoidance warning system, DCS built upon this original design to integrate a LiDAR-based CAWS component that now provides customers with a complete VRU detection and mitigation solution. Using LiDAR technology brought unique benefits, including excellent day and night object detection and highly accurate distance measurement. The LiDAR selected was the Leddar™ M16 2D flash LiDAR from LeddarTech based on primary performance drivers, communication protocols available (CAN) and cost.

PASS' CAWS uses the Leddar M16 LiDAR modules to generate a front-facing field of view (FoV) of 150 degrees. This FoV provides coverage of the critical A-pillar blind spot and other forward-obstructed views. Raw echoes from the sensors generated in polar coordinates are converted to Cartesian coordinates for use by the PASS algorithms to track an object's relative velocity and acceleration with respect to the transit bus.

Flash LiDAR Sensor Integration

DCS designed ruggedized enclosures to house the Leddar M16 LiDAR modules. PASS assembles three sensor housings into an assembly (see below) that is mounted and integrated into existing standard front bumper stand-offs placed below bike-rack assemblies. This mounting position avoids negative impacts to driver's visibility, simplifies transit agency maintenance procedures and provides unobstructed access to bike-rack access by users. The on-board operator feedback system is tunable to transit agency requirements and is sized and mounted to avoid obstructions to the driver's view.

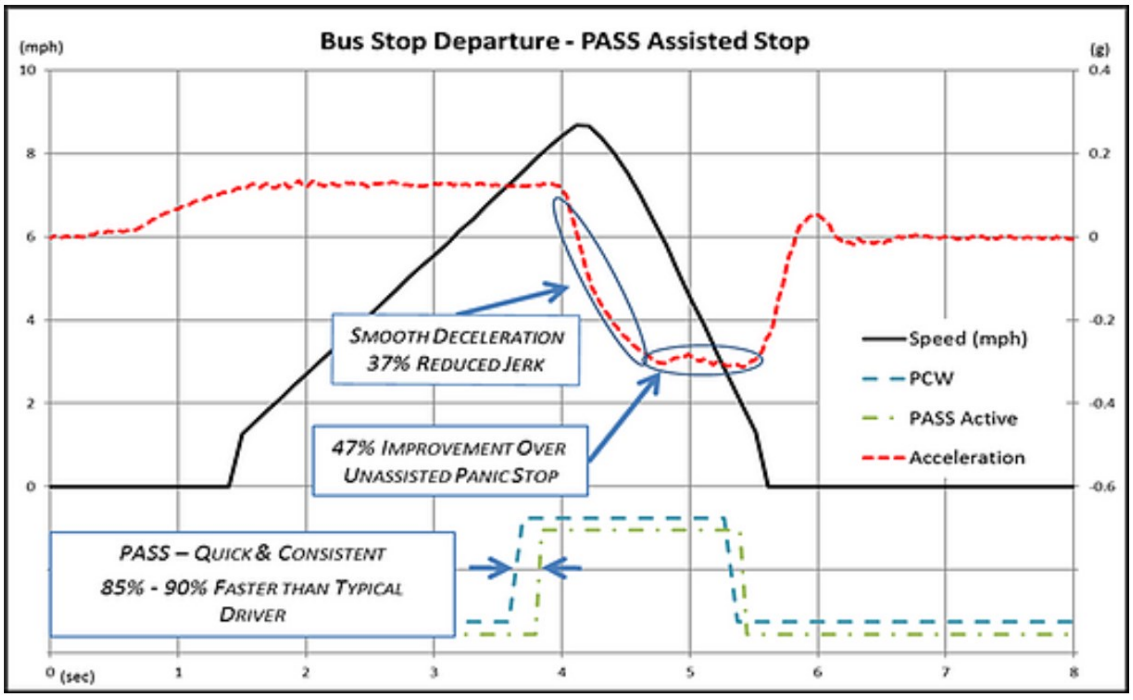


3. The Outcome

According to Dan Sellers, Senior Engineer at DCS Technologies, using LeddarTech's flash LiDAR solution provided significant benefits for the PASS system, including:

- Accurate detection and object distance measurements
- Sufficient range for transit bus requirements
- Availability of standard communication protocols
- Robust and reliable design, allowing for high reliability
- Small size for easy integration
- Cost point in line with transit bus budgets

"Adding PASS technology to passive detection systems allows reaction times 50 times faster than a typical human, resulting in immediate reductions in vehicle speed. With active vehicle control, drivers have more time and distance to bring buses to a controlled stop. During our product testing, results showed PASS reacts to pedestrian hazards up to 2 seconds faster than a driver with passive-only indicators, and reduces panic stop severity by 50%," stated Mr. Sellers.



PCW = Pedestrian collision warning system. Alerts the driver that there is someone in the path.

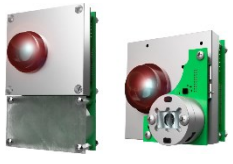
Source: DCS website

About DCS

Founded in 2003 and located near Indianapolis (Indiana), DCS provides hardware and software solutions to clients across the transit, automotive and defense industries. From transit hybrid power-train system controls to military-grade hardware electronics design, DCS provides practical solutions to real-world problems. www.dcsfusion.com/

Related LeddarTech Products

Leddar™ Sight
2D flash LiDAR sensor



Leddar™ M16
2D flash LiDAR modules