Oregon Department of Transportation

Stage 1 Research Problem Statement

Number 25-02

Proposed Title: Evaluation of Connected and Autonomous Vehicle Readiness of Oregon's Highways

1. Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

The American association of state highway transportation officials (AASHTO) recognizes that future vehicles will be connected and automated and that State DOTs need to have a Connected and Autonomous (CAV) deployment readiness strategy. To ensure safety for all users, AASHTO recommends that Infrastructure Owners and Operators (IOOs) actively test and deploy CAVs to better prepare for future CAV implementation. Autonomous vehicles (AV) use data collected from cameras, radar, LiDAR, Global Navigation Satellite System (GNSS), and computing algorithms to detect their surroundings. Autonomous vehicles can also provide increased mobility to seniors, children, people with disabilities and others who are unable or choose not to drive. For example, residents who live in rural areas have experienced difficulties/challenges in accessing activities or services due to lack of easy-to-use transportation that have undermined most residents' ability to live in well supportive environment. Autonomous driving system (ADS) technology can be a solution to address this issue by making transportation more accessible to many residents in rural areas and enhancement of residents' quality of life in Oregon. To fully deploy CAV operations on public roads, ODOT needs to understand the needs of CAV technologies, their benefits, and how to prepare for CAVs. This project proposes to conduct a series of test drives using a University of Nebraska-Lincoln (UNL)-owned ADS equipped vehicle. The UNL ADS consists of a LiDAR, a radar, two cameras, robot operation system (ROS), global navigation satellite system (GNSS), etc. (Fig. 1) that is equipped with an AI-based vehicle-to-everything (V2X) communication capacity to enable cooperative driving demonstrations to provide ODOT with the necessary information to allow the agency to assess CAV impact on operations, traffic engineering, construction, maintenance, and information technology.

(a) UNL Autonomous vehicle (b) LiDAR sensors and data processing (c) Signal/sign recognition

Figure 1. Autonomous driving systems and capacity.

2. Document how this **transportation issue** is important to Oregon and will meet the Oregon Research Advisory Committee Priorities

The intent of this research project is to pave the way for ODOT to have discussions about: (1) future plan for CAV deployment; (2) education (educating and communicating CAV developments to ODOT staff, public, partners, and stakeholders); (3) physical and digital infrastructure (assess capacity to support CAVs); (4) connected vehicle roadside unit (RSU) cellular vehicle to everything (C-V2X) communications to CAV on-board units (OBU); and (5) data (CAV data uses) (Figure 2).

The insights gained from the CAV project will be applicable to many other problems addressed by the ODOT's mission. This research topic is directly applicable to ODOT's mission to provide "a safe and reliable multimodal system; ensure safety and embrace equity", and is also directly applicable to ODOT's theme of Strategic Action Plan which states that ODOT "is building a system that seamlessly supports daily life and a strong, diverse economy".

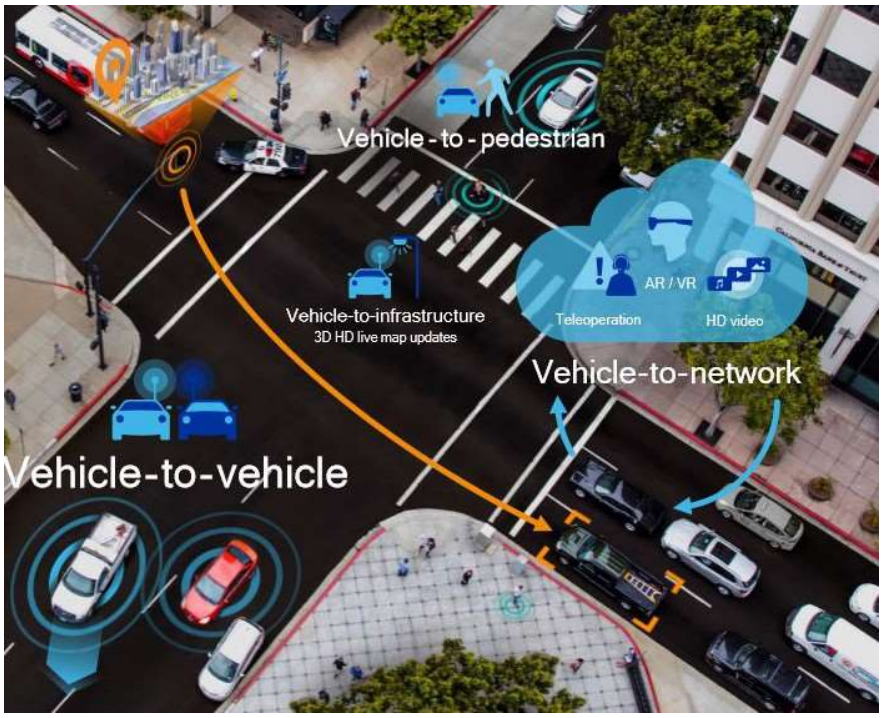

Figure 2: Demonstration of CV2X communication

3. What **final product or information** needs to be produced to enable this research to be implemented?
The outcomes of the project will help ODOT:

- Ensure safety and mobility for CAV users and the traveling public.
- Prepare and develop its current workforce with its CAV initiatives.
- Determine current infrastructure readiness for CAV technology by analyzing sensor accuracy of roadway elements necessary for CAV operation, including striping, signing, signalized intersections, work zones, variable message signs, and variable speed limit signs in and around Portland metro area.
- Verify existing Salem Mission Street traffic signal RSU communication with CAV OBU devices using C-V2X communications.

4. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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Jason Shaddix	System Operations and ITS Manager	jason.p.shaddix@odot.oregon.gov	503.378.2914
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Blaine Van Dyke	ITS Connected Vehicle Engineer	blaine.vandyke@odot.oregon.gov	971.707.8983

5. Other comments:

The project will be implemented by multi-disciplinary team members consisting of civil and transportation engineering, construction, electrical engineering, computer science, and computing. The PI is currently leading the Autonomous Vehicles and Robotics Laboratory at UNL and will oversee the entire project implementation and coordinate with ODOT staff.

The following is a tentative list of expected tasks to complete the proposed research project, which is subject to change in consultation with ODOT research personnel/TAC:

1) Development and assembly of CAV suitable for the need and operational environment of ODOT.
2) Initial Testing of CAV: The CAV will be tested in a controlled environment with scenarios designated to test the effectiveness of ADS technology in object detection and maneuvering without little to no human input. The roads where the CAV will be deployed will be determined jointly with the ODOT personnel.
3) Prototyping of CAV Technology: the team will work with ODOT to perform full scale CAV operations on selected public roads in the Portland and Salem areas and collect performance data for reviews by ODOT staff and stakeholders. Th focus of CAV prototyping will be focused on CV2X communications and road infrastructure readiness.
4) Final documentation and Report.

6. Corresponding Submitter's Contact Information:

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