Youngstown State University
Data Mining: Ohio's Rural Automated Driving Systems (Rural ADS)

Academic Year: 2023-2024

DriveOhio

Advancing Smart Mobility

Table of Contents:

DriveOhio

What is DriveOhio?

DriveOhio was established by Ohio Governor John Kasich in 2018 and reauthorized by Governor Mike DeWine in 2019.

DriveOhio is an initiative of the Ohio Department of Transportation and is the state's innovation hub for smart mobility.

The DriveOhio mission is to create pathways for the use of smart mobility technologies that increase safety, enhance mobility, expand access, and attract, prepare, and retain Ohio's talent. We connect government, industry, and academia to support research, development, testing, and deployment of innovative solutions to Ohio's mobility challenges.

Data Mining: Ohio's Rural Automated Driving Systems (Rural ADS)

What are Automated Vehicles?

Automated vehicles (AVs) are equipped with technology that can sense the environment and make decisions based on what is detected. Advanced driver assisted systems, such as adaptive cruise control, automatic parking, and collision avoidance, are the first widespread automated systems. Fully automated, or self-driving, vehicles can perform all driving functions without human intervention. The primary goal of development across the spectrum of automated vehicle technology is to improve safety by mitigating human error by decreasing response time and improving visual awareness.

DriveOhio's Rural ADS project will demonstrate how connected and automated semi-trucks and passenger vehicles could improve safety for drivers, passengers, and other travelers in rural settings. Passenger vehicles will be operated by professional drivers in Athens and Vinton counties to see how they navigate roads with no pavement markings; in straight, hilly, and tree-covered terrain, and at intersections. These passenger vehicles will demonstrate partial SAE Level 3 automation technology, allowing the vehicles to make decisions for themselves, such as passing a slow-moving vehicle, but still allowing transfer of control to the human operator.

Truck Platooning

Trucks will demonstrate deliveries throughout Ohio using platooning technology. Platooning is the linking of two or more vehicles using vehicle-to-vehicle communication technology where the trailing vehicle is notified of the driver inputs from the lead vehicle and eliminates perception/reaction time distance needs.

This will test partial SAE Level 2 (ADAS) automation technology in single tractor and platoon modes in 2 Class A tractors including Bosch ADAS technology and wireless vehicle-to-vehicle (V2V) communication. The data collected out of each demonstration workstream (passenger vans (SAE 3), trucks (SAE 1|2)) will help to identify system performance and challenges that the rural environment including roadway infrastructure pose for advanced technologies.

Truck data is streamed in near-real time to be stored and analyzed in the cloud, and all data from both deployment workstreams can be connected via timestamps and other metadata reflecting location, route, or other characteristics.

Data Mining Workstream

The Data Mining Workstream will focus on the automated passenger vehicle deployments and data gathering efforts. The passenger vehicles have been upfit with sensors and other technology to support automated driving. These upfit vehicles will be exploring the systems' performance in rural areas to identify points of interest where the technology may not perform as well as expected. The data collected during these deployments will include data from the sensors directly, the perception outcomes of the autonomous stack used (Apollo or Autoware), and any decisions the autonomous stack made based on those sensor inputs and perception algorithms.

The deployment teams will use the outcomes from this workstream to inform additional data collection runs that may be useful in helping to provide as complete a picture of the specific challenging characteristics facing the autonomous driving technologies in a rural environment.

First, this workstream will work with the datasets that have been collected to date to train AI/ML models on points along the data collection routes where the vehicles did not perform as expected. Then this team will work to identify other potentially challenging areas along predetermined routes where the vehicles may also have non-ideal performance. Following additional supporting data collection, this team will analyze the resulting data to illustrate what combinations of environmental (or other) characteristics pose an increased challenge to the autonomous technologies.

Corporate Partner Mentor:

Punit Tulpule: Dr. Tulpule is an Assistant Professor of Mechanical and Aerospace Engineering at The Ohio State University. He received his PhD from Iowa State University in Mechanical Engineering in 2014. His research interests include: model-based design, control of dynamical systems, and autonomous driving, more specifically safety of autonomous driving and fuel efficient connected and autonomous vehicles. His expertise is in modeling, simulation, and control of dynamic systems, applications of control methods to automotive engineering, and uncertainty and robustness analysis pertaining to simulation-based testing.

Subject Matter Experts:

Jay Wilhelm: Dr. Wilhelm is an Associate Professor of Mechanical Engineering at Ohio University. He received his PhD from West Virginia University in Mechanical Engineering in 2010. His research interests include aerial robotics, energy neutral sensors, UAV design and testing, and flight simulation. Dr. Wilhelm also has several published journal articles, conference proceedings, and patents.

Bryan Kowalczyk: Bryan Kowalczyk is a Senior Research Associate of Digital Futures at the University of Cincinnati focused on Aerospace Engineering. He is the co-director of the Applied Autonomy Lab at UC Digital Futures. His professional interests include flight testing, guidance, navigation and control, intelligent systems, systems engineering, test and evaluation, and uncrewed systems.

Rich Granger: Rich Granger is the Managing Director of Workforce and Economic Development at DriveOhio. He works with public and private partners to launch and manage a portfolio of workforce development programs to up-skill and prepare Ohio's existing and emerging workforce for the future of smart mobility. Additionally, he collaborates on economic development initiatives with partners across K-12 and higher education, automotive and logistics industries, technology startups, transit agencies, government, non-profit, economic development, and metropolitan planning organizations.

Nick Hegemier: Nick Hegemier is the Managing Director of Infrastructure for DriveOhio, where he oversees the development of Ohio standards for the deployment of connected and automated vehicle technology. He collaborates with various technology industry partners on the development and testing of new products for use in the areas of intelligent transportation systems and connected/automated vehicle technology. This is done with a goal of improving operations by creating efficiencies within the department through use of technology and the data it enables. He is skilled in connected/automated vehicle technology, traffic engineering, transportation engineering, highways, government partnerships, technology budgeting, and urban planning, with strong business development professional skills and a bachelor's degree in electrical engineering from The Ohio State University.

Tim Seitz: Tim Seitz is a research and development engineer at the Transportation Research Center Inc. (TRC), where he designs and conducts tests to determine the safety and effectiveness of automated vehicles and their components, analyzes and reports testing data results, instruments vehicles with equipment, and writes customized programs to analyze data and perform vehicle tracking. He is an experienced researcher with a PhD in Mechanical Engineering from The Ohio State University. He has a history of working in the connected and automation industry. He is skilled in vehicle instrumentation, data analysis, research and development testing, and is a strong research professional.

Student Roles and Responsibilities:

The most successful teams have clearly defined roles and responsibilities. These may be rotating roles throughout the semester, but this area is a starting point of discussion.

Roles may include:
• Project Manager/Scrum Master (TA)
• Data Visualization Specialist
• Front End Developer

Background and Preparation:

• Student should review the following to better understand the project:
  Ohio Rural Automated Driving Systems | DriveOhio

• Project Management System: Asana

Technical Requirements:

• Database: Dynamo DB or Mongo
• Utilizing AI/ML Principles
• Coding Language: Python

Students will be responsible for supplementing data by augmenting datasets for categorization.

Data Security and Boundaries:

Students will have to comply with Ohio ADS data security regulations. These include using a secure VPN when accessing datasets, or other state approved encryption. Additionally, secure encryption is required when data is being sent via email or other online communication.

Implementation Plan:

- Provide roadmap/timeline of how the project will be executed.
- Outline key milestones and objectives for the team to create.
- Please budget time for team bonding and student learning.
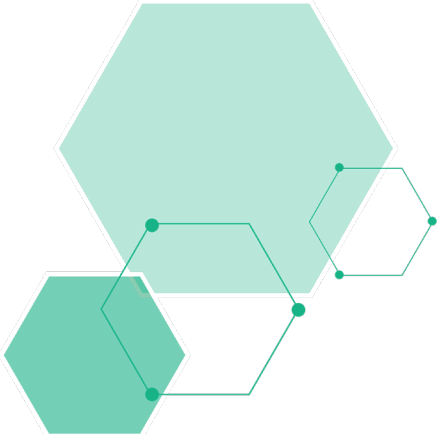
The Data Mine Corporate Partners Fall Roadmap	
Sprint 1	Launch and Ramp-up
Sprint 2	Defining Models
Sprint 3	Building and refining models, define and build environments
Sprint 4	Analysis and Outcomes
Sprint 5	Analysis and Outcomes
Sprint 6	Analysis and Outcomes
Sprint 7	Analysis and Outcomes
Sprint 8	Final Results

We look forward to working together!

for more info visit driveohio.gov

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