

Maryland Connected & Automated Vehicles Working Group

December 4, 2024





MOTOR VEHICLE ADMINISTRATION

Chrissy Nizer

Administrator Maryland Department of Transportation Motor Vehicle Administration Governor's Highway Safety Representative Co-Chair of the Maryland Connected & Automated Vehicles Working Group



2024 Accomplishments

Posted on the Maryland CAV Website.

https://cav.mdot.Maryland.gov



Public Outreach and Education

- MDDT developed is none (28 gags as a territory inductational decompt), sy help define CRC the parameter terminities of CRC and current CRC inclusion is Macapuel, This Type is available for use by all CRC partners, and consumpt entropies on the CRC analysis.
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Early Deployment and Testing

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Transportation (UDID) spontaned a tigh school essay content and achievening program with Partners for Automated Venico Education

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for Maryland at the Waryland Chapter for the Institute of

Transportation Emphasists

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to culturing also a future well automated vehicles. In this tool arrively partners, applications disclosed with the help of MD GMP pertners, and a

City budget edgester to the company working with the Union-shy's Balance Descentions (apply to investigate which yestellines and providing conflicts of appendial intersections

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Planning and Policy

- The Manyland Department of Planning continues announcing and advising local governments to prepare their built environment to include CAVs through planning policies in local comprehensive plant. At least 1% local jurisdictions new include CAV-related information and policies in their plants.
- The Baltimore Metropolitan Council held two meetings with local and State CAV stakeholders to continue the regional discussion on proparing for CAVs initiated by their outlier regional CAV project to develop <u>CAV Recommendations</u> and a <u>User Guide</u>.
- The Maryland Insurance Administration continues to monitor and maintain an awareness reparting liabidity, physical damaps cost multications, and potential definition changes with Advanced Driver Assistance Systems (ADAS) and CAV. The Administration is coordinating with the National Association of Insurance Commissions (HAC) as been practices and polaticits develop.

Infrastructure

- The State Highway Administration (SHA) continues to confinate with local agencies and partners on the need for and deployment of a statewise security certificate health monotonic quarbiand for Connected Vehicle (CV) equipment. This aims to ensure that all CV Roadside Units (RSUs) and Oriboard Units (RSUs) have valid certificates for accurate message deflow y and receipt.
- Manyland was awarded three Strengthening Mobility and Revolutionizing Transportation (SMART) grants from USDOT, Grants were awarded to:
- Maryland Transit Administration IMTAI for transit signal priority.
 Maryland Department of Planning for Eastern Shore drone medical defivery.
- SHA to study work zone speed data using innovative drone technologies.
- 6 SHA now monitors major antarial controlors and more than 1,800 signalized intersections statewide using third-party CV data. This application allows SHA personnal to identify and address operational and maintenance issues on the fly. It also gives staff an opportunity to schedule prioritized aquipment repairs when accessary.
- Maryland is partnered with other state DOTs as part of an Automated Vehicle Pocled Fund Study, led by the Ohio Department of Transportation, to research issues that will affect the deployment of automated vehicles by state transportation agencies.

Workforce M00T hosted many internal workforce development Lunch and Learn webinan- both M00T-wide and for specific modes.

MODT inclinated a Maryland Foundational VIX Training by USDOT, in partnership with Morgan State University and the Intelligent Transportation Society of Maryland to introduce kay components that snable a VIX ocception, potential benefits of the technology, example use cases, and the messages and standards that support them while ensuing asheet and privacy. More than 7.9 participant, inclusion

many State and local government infrastructure owner operators who

control potential deployment of this technology. Maryland continues to be recognized for its CAV collaborative efforts as several other state DDTs, including North Carolina, Louisiana, and Michigan and a National Cooparative Highway Research Program (INCHRP) research scen all invited MD CAV to share expertises and experimence.

The Maryland CAV Working Group containers in factor central point of coordination for the development and deployment of emerging CAV tachetidoges in Maryland. 2024 Meetings:

Held at Morgan State University

- Demonstrations and Presentrations from Connected Vehicle • Kakibot technology vehicles • University of Maryland Build • Morgan State University America Center • Mobilers
- August Hald at the National Federation of the Blind Demonstrations and Presentations from Next generation of the Meesal on Uniform Traffic Control Devices (MUTCD): Preparing for Automated Vahielas Women Wolken with
- state and local government leaders • National Federation of the Bine • Nam

December Held at the Cruise Maryland Terminal

Consortations and Presentative from
 C-V2X from the Auto
 Manufacturer Perspective
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 Covbot





Older Driver Safety Awareness Week

- Find more information at the <u>National Highway Traffic Safety</u> <u>Administration</u>.
- Advanced driver assistance systems, or ADAS, can detect dangers and provide warnings, steering, or braking support to all drivers, including older adults.
- Many mature drivers are unaware of ADAS, but can adapt to new technologies if they receive sufficient training and exposure opportunities.
- Education by dealers, government agencies, and the private sector focused on mature drivers and their limitations – will be key to ensuring they not only accept technology but embrace it.



CAV Updates: AV Policies

- U.S. National Highway Traffic Safety Administration (NHTSA) and the United Nations Economic Commission for Europe (UNECE) issued regulations on ADAS.
- Locally, Pennsylvania DOT adopted new guidelines, called Publication 950, for the operation and testing of highly automated vehicles on Pennsylvania roadways.
- PennDOT's new guidelines define minimum requirements for the operation of driverless vehicles without a backup safety driver as well as for the remote operations of a vehicle.
- The European Union has included requirements for remote intervention operators and in the U.S., the Automated Vehicle Safety Consortium developed best practices for remote assistance.



MARYLAND PORT ADMINISTRATION

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AUDI AND PARTNERS FOR AUTOMATED VEHICLE EDUCATION (PAVE)

Brad Stertz

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Short Break

Agenda

MARYLAND DEPARTMENT OF TRANSPORTATION





PARTNERSHIP PROJECT – UNIVERSITY OF MARYLAND AND MORGAN STATE UNIVERSITY



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ADAS 101: Understanding Your Vehicle's Safety Features









CAV Collaborative Research

Terry Yang University of Maryland Mansoureh Jeihani, Di Yang Morgan State University









Protecting Vulnerable Road Users Through Smart Infrastructure







What is LiDAR



Tilting mirror Optical rotary encoder Servo motor Laser source Receiver LIDAR is a method for measuring distances (ranging) by illuminating the target with laser light and measuring the time the reflection of the light takes to return to the sensor. Two types: Mechanical LIDAR sensors: cove 360 degree (16 lines ~128 lines)

Quasi-solid-state LiDAR sensors: directional, no rotating parts SCHOTT/Cepton/LSIS/HESAI, etc. Very active market to meet the smart mobility needs **Cannot penetrate mental frame or human body** The point cloud will be bounced back.

LIDAR sensors are "eyes", not "brains"



LiDAR vs. Other Sensors

LIDAR's prominent performance in tracking in dark conditions



High-fidelity raw data (point cloud) create a high ceiling of detection accuracy



Source: https://www.fierceelectronics.com/components/lidar-vs-radar

Source: Cepton Inc.



3-D measurement (length, width and height)



Utilizing LIDAR sensors to detect pedestrian movements at signalized intersections









Four Steps







Install and align sensors

Draw Zones on the web interface





et up central system for analytics











Visual verification



Connected Vehicle Testbed at Morgan State University

LiDAR sensors, Roadside Units, and CCTV cameras are installed on two signalized intersections at Morgan State University campus to develop a Connected Vehicle (CV) testbed



Mixed Traffic CAV Testbed







Object Tracking



Traffic Measures

- Traffic mobility and safety measures can be extracted directly from the testbed





Pedestrian outside of the crosswalk



Fraffic Conflict Examples



Traffic Measures

- Traffic mobility and safety measures can be extracted directly from the testbed



w Light Runners

Phase Interval



Traffic Measures

- Traffic mobility and safety measures can be extracted directly from the testbed



w Light Runners

Phase Interval



Connected Vehicle Equipment

The Onboard Unit (OBU) enables
 cars to communicate with other
 vehicles (V2V communication) and
 infrastructure (V2I communication)
 in the surrounding environment.





Connected Vehicle Equipment







Improving Safety Performance of CAVs with Cooperative Perception







Tesla Robotaxi











Detection Challenges: "Blind Spot"









Cooperative Perception

Cooperative Perception (also known as collective perception) refers to the concept where multiple connected vehicles and infrastructure (such as roadside sensors or cameras) share their real-time perception data to improve situational awareness and safety. This is particularly useful in situations where an individual vehicle's sensors may be obstructed or have limited range.









LiDAR + CV (C-V2X)



Ped Info via I2V (LiDAR \rightarrow RSU \rightarrow OBU)



https://www.youtube.com/watch?v=yaLPUo2RWIQ

Video based CP with V2I

CP with V2V Communications

Connected Vehicle with Vision Support

Non-connected Vehicle

Step 1: Video Processing on each connected vehicle

Step 2: Construction of dynamic Ad-Hoc Sensor Network

Car C

Car A

Car

Step 2: Construction of dynamic Ad-Hoc Sensor Network

UMD In-house CAV

Metrics for Evaluations

Impact Category	Metric	Description
Safety	Vehicle-to-Vehicle Crash	Compare collision rates before and after CP
	rate	implementation.
	Vehicle-to-VRU collision	Assess the reduction in accidents involving pedestrians or
	frequency	cyclists.
	Time to Collision (TTC) improvement	Measure improvements in TTC for potentially hazardous situations.
	Near-miss frequency	Count reductions in incidents where collisions are narrowly avoided.
	Emergency braking	Quantify the decrease in last-moment emergency braking
	activations	events.
Efficiency	Average vehicle speed	Evaluate whether CP allows for consistent speeds, reducing unnecessary deceleration.
	Traffic throughput at	Measure vehicle throughput in occluded or complex
	intersections	intersection scenarios.
	Frequency of deadlock	Count how often mutual occlusions cause deadlocks and
	occurrences	the impact of CP in resolving them.
	Fuel consumption or energy efficiency	Assess energy savings through smoother driving enabled by CP.
Cost	Communication	Measure the amount of data transmitted under different
	bandwidth usage	fusion strategies.
	Computational load	Evaluate the processing power required for early vs. late fusion.
	Scalability	Determine the system's ability to handle an increasing
		number of agents or data streams effectively.

Spatial and Temporal Synchronization

Communicate Only Necessary Information

CP Scenarios

Application	Scenario	Description
VRU	#1: VRU awareness	Using CP to inform vehicles about VRUs at mid-block
Protection		crossings or intersections.
	#2: VRUs jaywalking	Using CP to alert vehicles when jaywalking VRUs is detected.
	#3: VRU in "blind spots"	Using CP to detect VRUs when they are occluded by large vehicles (e.g., buses).
Collision Avoidance	#4: WWD warning	Using CP to inform vehicles about wrong-way driving (WWD).
	#5: Car-following alert	Using CP to inform vehicles about a sudden braking event
a a :		downstream by a non-connected agent.
Conflict Avoidance	#6: RLR warning	Using CP to respond to potential red-light running (RLR) proactively.
	#7: Permissive left-turn	Using CP to have CAV conduct permissive left-turn at signalized intersections.
Enhanced Situational Awareness	#8: Line-of-sight assist	Using CP to navigate difficult geometric conditions that may affect line-of-sight.
	#9: Adverse weather assist	Using CP to assist in adverse weather limiting line-of-sight.
	#10: Work zones assist	Using CP to assist vehicles in navigating work zones.

PARTNERSHIP PROJECT – UNIVERSITY OF MARYLAND AND MORGAN STATE UNIVERSITY

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KIWIBOT

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Urban Infrastructure

Past, Present and Future

Since its inception at the UC Berkeley Skydeck accelerator program in 2017, Kiwibot has deeply integrated into communities, where robots are now an accepted part of daily life. By 2024, Kiwibot is present on 20 college campuses in the US, partnering with major vendors like Sodexo and Grubhub. Kiwibot's applications extend to hospitals, corporate campuses, malls, smart cities, and any last-mile environment. The company is capable of manufacturing, adapting, and implementing both customized and third-party robots.

Autonomous Process

Kiwibot urban inspection and autonomous mapping

Kiwibot's urban inspection and autonomous mapping process enables the government to address the complex challenges of modern governance by incorporating data collection on sidewalk risks and hazards. Monitoring and tracking these potential risks allow for the identification and mitigation of hazards, helping to prevent economic disruptions caused by public demands and safety violations. Demonstrating a commitment to hazard tracking and management helps build public trust in the government and its ability to protect and serve the community.

Project stages

No Standing or Parking w/Green Exception

Can you see the supports	yes
Can you see if the sign is there	yes
Can you see it from the other side of the street	yes
Can you confirm what type of sign is there	yes
Select relevant picture	zoom

1.Define the area

3

Select the area to be analyzed and delimited the project

2. Mapping the area Mark the points and save the coordinates

3. Data Collection Check and audit the hazards or risks

Project stages

4. Data evidence Save the pictures to track the hazards and risks

5. Mapping and data analytics Save the data of the hazards and risks

Business Case

Kiwibot firmly believes that smart cities are strongly dedicated to the seamless technological integration of robots within secure ecosystems operating 24/7.

The project focuses on gathering information about sign locations, sign statuses, and pathway quality.

Mapping urban landscapes is a complex task that requires precision and efficiency. Utilizing robots for this purpose presents a modern solution, offering a range of benefits:

Continuous Operation Safety Advanced Operation Cost-Efficiency Accuracy Navigational Abilities

Business Case

Thanks

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STARSHIP

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STARSHIP

Maryland Connected & Automated Vehicles Working Group

STARSHIP

December 4,2024

We're revolutionising last-mile delivery on a global scale

Sensor suite

12 cameras, 8 ultrasonic sensors Time-of-Flight cameras, Radar.

Maximum speed 4 mph software-limited

Detection of objects and obstacles by using the sensor

traffic avoidance

suite & neural networks and intelligent

A 'Bubble of Awareness': developed over 7 years

- High level of autonomy
- Human operator back up

Low speed and weight

Capacity

Carries 2-3 shopping bags

Human operators monitor and occasionally guide

robots from remote centers

Computer vision & GPS

using proprietary mapping

Bogie system for climbing

(20lbs) in a locked

compartment

3D mapping

and navigation

Curb Climbing

BOWIE STATE

- Fall 2024 launch
- Delivery with meal plans
- Events with the university

STARSHIP

Juan Canahui

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Adjourn

Remember to visit with UMD, MSU, Kiwibot, and Starship just outside and see their demonstrations!

Reach out anytime with ideas and questions! cavmaryland@mdot.state.md.us cav.mdot.maryland.gov

