Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

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Michigan facilities support connected vehicle research

Connected vehicle and smart road technologies have the capacity and potential to increase mobility and improve safety on Michigan's roadways. The Michigan Department of Transportation (MDOT) works with research and industry partners to ensure these technologies are developed and deployed safely. The Michigan Mobility Transformation Center, also known as Mcity, and adjacent testing areas have proven to be a significant catalyst for ground-breaking intelligent transportation system (ITS) research that supports MDOT in making well-informed management and investment decisions regarding smart infrastructure.

PROBLEM

As a leader in the automotive industry and ITS, Michigan is home to researchers, technology providers and others who develop connected and automated vehicles (CAVs) and related infrastructure technologies. As many roadway configurations and conditions can affect CAV operations, it's imperative that vehicles are able to consistently communicate with each other as well as with transportation infrastructure. Researchers and developers, often in collaboration with MDOT, need to thoroughly test CAV equipment and systems under controlled and realistic settings.

Along with the University of Michigan, MDOT leads the Ann Arbor Connected Vehicle Test Environment (AACVTE). Established in 2012, AACVTE is an operational test bed of communications and other infrastructure technologies allowing connected vehicles to communicate with each other and with infrastructure components such as traffic signals.

Mcity includes a variety of types and colors of lighting to help evaluate how connected and automated vehicles detect road and lane boundaries, as well as obstacles in the roadway.

Additionally, MDOT helped to sponsor the construction of the Mcity test facility in conjunction with the University of Michigan's Transportation Research Institute. The Mcity test track, perhaps the world's first purpose-built test environment for CAVs and related technologies, is dedicated to developing and testing CAVs and infrastructure systems. Set on 32 acres, more than half of the complex is comprised of roads and traffic infrastructure with characteristics representative of urban, suburban, and rural areas.

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"Mcity and its connected infrastructure have catalyzed good relationships among MDOT, researchers and technology providers. This research illustrates the facility has the support and capabilities to continue to be the ultimate proving ground for ongoing ITS research and learning."

Collin Castle, P.E.
Project Manager

MDOT wants to optimize its ITS infrastructure investments and ensure these testing grounds remain flexible and adaptable as technology continues to improve. A review of the attributes, capabilities, operations, and activities at Mcity and the adjacent testing area will support smart technology decision-making among MDOT and its collaborators for years to come.

RESEARCH

Researchers reviewed Mcity's standard roadway features and infrastructure, as well as its advanced and adaptable traffic control and management system. The attributes originally built and subsequently added to Mcity include:

- A variety of roadway surfaces and other materials, such as pavement markings and various lighting types.
- Roadway characteristics and configurations including traffic signal positioning, tunnels, traffic circles, and highway attributes like guardrails and rumble strips.
- Road user amenities like crosswalks, parking configurations, bicycle racks, and mailboxes.
- Communication systems and capabilities between vehicles and infrastructure.

Next, the team reviewed the research and other activities conducted at Mcity by researchers, auto manufacturers, technology development companies, and others. Starting with basic vehicle sensor and algorithm development, testing individual vehicle attributes was followed by a focus on systems and protocols for three-way communications among vehicles and infrastructure. Significant research on LiDAR (light detection and ranging) was among the research conducted at AACVTE. Researchers described the interaction between Mcity and AACVTE and the synergies created between the two proving grounds.

RESULTS

From the review of Mcity's and AACVTE's histories and uses, investigators highlighted the successful collaborations among MDOT and its partners and the facility's industry-wide value for advancing ITS technologies. In addition to illustrating Mcity's continual improvement and capabilities for expansion, researchers identified lessons that have been learned since it was built:

Limitations on roadway configurations and attributes: While Mcity was built with a broad range of attributes representative of rural and urban road networks, developers soon realized that the scope that had been initially envisioned was not affordable or feasible in a facility of Mcity's size.

Differences between "as designed" and "as built": The infrastructure attributes were generally built to plan; however, even slight alterations or variations in materials used have occasionally resulted in unintended operational consequences.

Community curiosity and facility popularity: Because Mcity was the only complex of its kind when first built, public events have attracted large crowds and other developers interested in building similar facilities around the world. Some observers have even flown aircraft and drones overhead to see beyond Mcity's obscured fencing.

The AACVTE's synergistic relationship with Mcity has created additional capacity for research and testing. Although technologies for communication among automobiles and infrastructure have been explored at AACVTE, researchers are investigating some long-term issues with equipment providers' ongoing support, changes in industry standards and regulatory changes.

IMPLEMENTATION

Through Mcity and AACVTE, MDOT and its partners have developed and continue to operate a world-renowned complex devoted to advancing ITS research. The testing and experimentation conducted at these facilities allows MDOT to make good decisions on infrastructure investments, including when and where investments should be made to support future ITS research and development.

Research Administration

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This final report is available online at

www.Michigan.gov/MDOT/-/media/Project/Websites/MDOT/Programs/Research-Administration/Final-Reports/SPR-1695-Report.pdf.

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