STRENGTHENING MOBILITY AND REVOLUTIONIZING TRANSPORTATION | 2022

Leveraging Advanced Data to Deliver Multimodal Safety

Submitted by: Nashville Department of Transportation
In Partnership With: UTC, TSU, Vanderbilt Universities

NDOT

THE UNIVERSITY OF TENNESSEE CHATTANOOGA

TENNESSEE STATE UNIVERSITY

VANDERBILT UNIVERSITY

PROJECT NARRATIVE

OVERVIEW / PROJECT DESCRIPTION

The Leveraging Advanced Data to Deliver Multimodal Safety (LADDMS) project advances the Nashville Department of Transportation (NDOT) and Multimodal Infrastructure's Vision Zero Action Plan by improving data quality, prioritizing equity, and increasing collaboration and transparency by partnering with local Tennessee universities to provide visionary analysis for safety improvements in North Nashville.

The LADDMS project is a research collaboration effort with NDOT, University of Tennessee (Chattanooga), Vanderbilt University, Tennessee State University, Tennessee Department of Transportation (TDOT), and other local stakeholders. This project will identify safety incidents outside traditional crash reports, implementing targeted safety measures, and evaluating these measures in Nashville's multimodal environment under the city's Vision Zero Implementation Plan. This project will benefit the North Nashville area by improving safety to all transportation network users with an emphasis on pedestrians and bicyclists who have been traditionally underrepresented in safety studies.

Real World Issues and Challenges Addressed

Currently, NDOT relies on crash reports from the Nashville Police Department, which are infrequent data points and often contain limited information when analyzing safety through a transportation lens. We also lack a method of tracking "near-misses" with pedestrians and cyclists. These issues then compound during the crash report evaluation process used to prioritize safety improvements.

Years of under-reported collisions with pedestrians and mobility-impaired individuals coupled with traditional methods of crash reporting have left gaps in the links between pedestrian safety and data accountability. This project addresses these challenges by using technology to work towards a safer environment for the citizens who use these streets through the identification of all conflict points within the studied area.

Proposed Technologies

The LADDMS project will use LiDAR, video and other sensor data to identify safety issues outside of traditional crash reports, inform safety measure implementation, and evaluate applied measures in the multimodal environments of key diverse neighborhoods. We intend to install the detection devices at key intersections and mid-block segments to collect near-misses, modal conflicts, bike and pedestrian counts, and signal operation deficiencies. The project team will use analysis and feedback to install effective, quick-build safety projects and evaluate the impacts of those safety projects for potential deployment at similar

locations city-wide. Examples of these quick-build safety projects include but are not limited to, curb extensions, pedestrian refuge islands, and rectangular rapid flashing beacons (RRFB).

The LADDMS project will install LiDAR and video camera technologies at key intersections and mid-block segments. We intend to install the video detection devices at key intersections and mid-block segments in Nashville's downtown core to collect near-misses, modal conflicts, bike and pedestrian counts, and signal operation deficiencies. The detection devices will also help the Department identify any unknown deficiencies in the transportation network, such as poor lighting or any other dangers contributing to pedestrian safety. NDOT plans to collect and evaluate "near-miss" data that would not be identified using traditional evaluation methods, enabling NDOT to further protect the transportation network's most vulnerable individuals.

Our university partners, who have been involved since before this writing, will be helping NDOT refine our concepts and evaluate our results. The University of Tennessee, Chattanooga has already implemented a similar innovative solution of their own. They have stationed LiDAR and cameras at intersections, aimed down mid-blocks that count pedestrian traffic with higher accuracy – all processed at the edge. The system provides real-time pedestrian and vehicle metrics including near-miss incidents. These incidents are used to identify localized features that contribute to recurring near-miss incidents. Thus, providing critical, otherwise unavailable, safety metrics that have enabled active and passive safety features.

Desired Outcomes for Stage 2 Grant

NDOT plans to expand and apply the successful practices to our other neighborhood segments along the city's High Injury Network, as NDOT executes the city's Vision Zero Implementation Plan. Phase II implementation projects will be expanded and applied to our other key intersections and mid-block segments. We will utilize transit ridership data from WeGo, Nashville's Metropolitan Transit Authority, to assist in our selection of future intersections and mid-block crossings located along corridors with local route bus ridership and pedestrian traffic. These selections will be cross-referenced with WeGo transit ridership data and the Vision Zero Action Plan to ensure the needs of the most at-risk users are met. TDOT's Multimodal Division has also partnered with NDOT to enable fast action on the state highways that run through Nashville. We have already been collaborating with them to combine our safety campaigns to demonstrate a consistent strong message of our Vision Zero goals. Furthermore, NDOT has standing meetings with Metro Nashville Police Department, TDOT, and the Tennessee Department of Safety and Homeland Security to discuss data consistency and transparency.

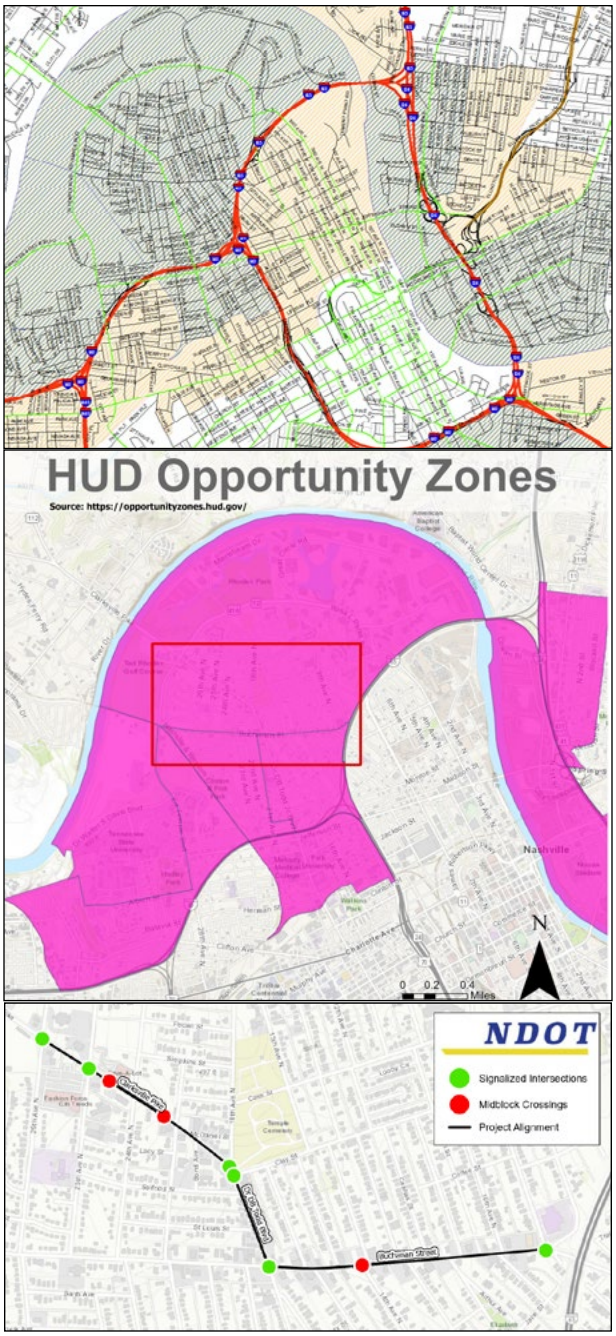
Improvement of Transportation System Status Quo

The SMART Grant will support three NDOT priorities, which are intended to improve the overall status quo of Nashville's transportation system. The first is deploying a robust fiber network to expand Smart Cities concepts throughout our downtown and along major arterials. Improving our connected/"virtual" infrastructure will enhance how the vehicular traffic network and pedestrian/other-modal users coexist safely and efficiently. Second, the Grant will support the goals of our Vision Zero Action Plan. As mentioned above, we need to investigate new ways of collecting data on near-misses, leverage emerging big data sources, and adopt innovative strategies and funding opportunities for user counts, while maintaining user counts along the Highway Improvement Network. NDOT and TDOT are currently designing/constructing arterial fiber along state highways, allowing the Departments to push larger volumes of data and providing backbone for temporary installations along the majority of the arterial network. Third, the project aims to enhance relationships with our residents and universities through a continued partnership into the Stage 2 Grant process and beyond.

> This project is another step toward making Vision Zero a reality in Nashville. The ability to gather real-time data that NDOT can use to protect the most vulnerable roadway users is an opportunity we don't want to pass up, and we're grateful to Tennessee's world-class universities for partnering with us on this important effort.
> *~ Diana Alarcon, NDOT Director*

PROJECT LOCATION

The project location is within Davidson County, Tennessee in the subarea of North Nashville and straddles the communities of Cumberland Gardens, Buena Vista Heights, Jones Buena Vista, and Elisabeth Park. The project corridor is roughly 2 miles from the downtown Nashville urban core with predominately single- and multi-family residential housing and commercial businesses. The roughly 2-mile project corridor starts at the intersection of Clarksville Pike and 26th Avenue North and travels southeast along Clarksville Pike to Dr. D.B. Todd Junior Boulevard. The project corridor then turns east onto Buchanan Street and ends at the intersection of Buchanan and 9th Street North. There are existing fiber optic lines beneath these streets that will be utilized for this project. In 2016, the US Department of Housing and Urban Development (HUD) assigned Nashville a Promise Zone designation, which encompasses the North Nashville neighborhood where our project is located. The Nashville Promise Zone's mission is to foster intensive partnerships among Nashville's organizations that serve high poverty neighborhoods, improve the collective impact of their service and address revitalization in a collaborative way. The project corridor has six signalized intersections and three midblock crossing locations. On the project location map legend at right, green circles indicate intersections and red circles indicate mid-block crossings. The North Nashville area is a midsized, urban part of the greater Nashville Metropolitan area. An area of interest within or adjacent to the project corridor is a large Nashville Metropolitan Development and Housing Agency residential area. Other notable corridor locations include the local Save-A-Lot grocery store at the corner of Clarksville Pike and 24th Street that serves as a community anchor, Temple Cemetery sites at the tri-corner of Clarksville Pike, 18th Avenue North, and Clay Street, and Jones Paideia Elementary Magnet School at the end of the project corridor.



The study area census tracts are located in one of Tennessee's Federally Designated Community Development Zones.

COMMUNITY IMPACT

The LADDMS project will provide direct safety improvements to the North Nashville area, a Historically Disadvantaged Community. This community will benefit by seeing less frequent and less severe crashes involving vehicles, pedestrians, and bicyclists as a result of applying state-of-the-art technology. Being the first neighborhood in Nashville to receive the proposed innovative safety technologies will also provide a visible example of equity in action in line with the City's Vision Zero Initiative to include leveraging some of Tennessee's top universities to directly address concerns in their neighborhood. For example, Tennessee State University, a historically black land grant university located within the project area's neighborhood, is Carnegie-designated a "high research" school with undergraduate and graduate degrees in engineering, technology, and computer science, among many others. The utilization of new technology will be a learning process for stakeholders within the project area and NDOT. Acknowledging that community members may have concerns about monitoring through surveillance, NDOT is committed to an educational component with the community and ensure any concerns are addressed through a community engagement process. Recently, an ordinance (BL2022-1470) passed unanimously through Metro Council amending the Code of Law to authorize the use of data collection and video technologies solely for the purpose of traffic monitoring and management by the Metropolitan Department of Information Technology Services and the Nashville Department of Transportation and Multimodal Infrastructure. The ordinance provides that this technology would be used for non-law enforcement purposes only. Through this learning process we hope to build trust and a sustainable partnership to support the city's long term vision of a people-first transportation system that works for everyone.

TECHNICAL MERIT OVERVIEW

One challenge in traffic safety analysis is the difficulty of data collection. Even though crash reports can provide a summary of the crash, the detailed accident scene cannot be restored. Traditional approaches of collecting crash data include driving simulation, naturalistic driving studies (NDS), and field observation. However, these approaches are subject to limitations such as personal privacy issues, data processing, and performance degradation due to weather or illumination conditions. Thanks to sensing technology, advanced traffic detection sensors deployed at smart infrastructure is a promising step towards addressing these challenges.

Of the many sensor options, video cameras and LiDAR are among the most popular for traffic data collection and detection. Video cameras are good for scene interpretation but, in addition to privacy issues, the detection performance is affected by weather and illumination. LiDAR sensors have the capability of scanning objects in 3D space and reporting their locations with great accuracy under different illumination conditions; however, they do not capture color and their scene interpretation is less sophisticated and straightforward than video cameras. Nowadays, image processing techniques from camera data can more accurately detect, classify, and track different road users using deep-learning methods such as YOLO (detection) and DeepSORT (tracking). The procedure of processing point clouds from LiDAR sensors is similar, i.e., in the order of background filtering, object detection (clustering), object classification (classifier training), and object tracking (Kalman filter). The obtained all-traffic trajectories store the position, speed, and direction. information of each road user at a high frequency, which is a valuable dataset for traffic safety analysis.

However, considering the pros and cons of each sensor as well as application requirements (project cost, detection range and accuracy, computational

cost, and environmental conditions), sensor fusion is a more promising approach for producing an adaptive, cost-effective, reliable, robust, information-rich, and user-friendly infrastructure-based traffic sensing system compared to either sensor functioning alone. Data fusion can be executed at data-level, feature-level, or decision-level based on the requirements and goals of a project. Major tasks include: 1) Data collection from multiple sensors simultaneously and separately for different traffic scenarios – the configuration and calibration process of sensors is required in a new environment; 2) Develop processing algorithms for individual sensors; We will leverage our existing work on video and point cloud analytics to accelerate the development of machine learning algorithms for detection, classification, tracking, and speed estimation of vehicles, pedestrians, and cyclists; 3) Develop algorithms for data fusion from multiple sensors; and 4) Evaluate the quality/accuracy of key measurements (e.g., traffic volume, classification, and speed) obtained from various scenarios with different combinations/priorities of sensors.

The primary benefit of this project is to provide NDOT with 24/7 high-resolution, high-accuracy traffic data for traffic-related analyses such as near-misses, modal conflicts, bike and pedestrian counts. Using near-misses as an example, researchers and traffic engineers could study vehicle interactions at multiple scales to define and extract near-miss events, identify traffic safety issues, and recommend countermeasures without waiting for historical crash records. Other benefits of available near-miss datasets include: before-and-after safety assessment of specific sites, and identifying the site with the highest vehicle-to-pedestrian crash risk from the site pools. In addition, our solution will also help automate the process of sensor configuration and integration, data visualization, analysis, and assessment, and will create an interoperable and transferable traffic sensing system that will not require NDOT personnel to deploy.

PROJECT READINESS OVERVIEW

Feasibility of Workplan

Our team is prepared to implement the project as soon as possible. NDOT and our university experts have been anticipating action items and can begin work immediately. We have generated a tentative timeline that will ensure progress is made and deadlines are met throughout. We have allocated contingency into our scheduling to account for any challenges or obstacles that may slow progress, such as inclement weather, technical difficulties, longer than expected lead times or other traffic disruptions and special events brought to our attention by local stakeholders in the area). Furthermore, UT-Chattanooga's previous installation of LiDAR and camera devices in their neighborhoods has paved a familiar path for us to apply our work in North Nashville. They have shared their experiences and local regulations that were applied to the work to account for legal permissions and community sensitivity. We expect our work to be carried out with minimal disturbance to all roadway network users, residents, and businesses at our project location. NDOT and university staff will also appoint community relations staff who will address any on-site concerns from members of the public during the time we are in the community.

A realistic workplan and timeline for completing our project is summarized below:

Months 1-4:

- Stakeholder outreach, notice of project implementation to surrounding neighborhood organizations, and businesses (NDOT, Universities, local stakeholders + Jones Paideia Elementary Magnet School)
- Begin enrolling local staff in workforce training sessions/classes to support tasks of the project (special consideration given to residents located in project area and students at TSU, the university in closest proximity to the project area)

Months 5-7:
- Incorporate feedback and data into project management plan (NDOT, Universities)
- Training sessions begin (virtual sessions followed by on-site instruction)

Months 8-15:
- Begin installation of LiDAR and camera devices at identified intersections and mid-block crossings (NDOT, Universities)
- Project lead staff, employees, and student workers implement majority of project tasks, including device installation, data collection practices, and quality control
- Training of local staff

Months 16-18:
- Monitor devices, ensure smooth operations of data connection and feedback mechanisms

Community Engagement and Partnerships

The LADDMS project is a research collaboration effort with NDOT, University of Tennessee (Chattanooga), Vanderbilt University, Tennessee State University, Tennessee Department of Transportation, and other local stakeholders. NDOT will be reaching out to local stakeholders, such as Jones Paideia Elementary Magnet School Coding Club, WalkBike Nashville, Nashville Civic Design Cener, Metro Nashville Police Department, the Equity Alliance, GNRC, TN Department of Health, and others. to gain their support. NDOT has a project website **https://www.nashville.gov/departments/transportation/traffic-management-center/smart-grants-program** to provide the public information regarding the project throughout its life.

NDOT will develop a public information campaign including stakeholders and the general public. As communities continue to diversify, we have placed emphasis on hiring multilingual staff who can more effectively communicate with our growing limited English proficiency populations. We plan to exceed the application requirements by targeting more than 40% of our budget and infrastructure to benefit our over-burdened populations. We anticipate the project benefits to most effectively reach our low-income residents, transit riders, bicyclists, and pedestrians (especially the large number of individuals experiencing homelessness) in the North Nashville area. NDOT will also reach out to historically disadvantaged community members for opportunities for employment or mentorship with this project. Senators Blackburn and Hagerty and Representative Cooper have provided Letters of Support.

Leadership and Qualifications

NDOT, under Director Diana Alarcon, will lead this effort. She has identified Derek Hagerty, PE as the Project Manager. Mr. Hagerty leads NDOT's Traffic Management section with a focus on safety and efficiency for all users, primarily through the application of technology. He is the day-to-day lead on standing up Nashville's first Traffic Management Center to include detection and performance metrics for all transportation modes.

As part of our research collaboration our university partners will also have leadership positions for this project.

Mina Sartipi, PhD, IEEE with the Center for Urban Informatics and Progress, will lead the efforts of the University of Chattanooga. Dr. Sartipi is the Guerry Professor of Computer Science and Engineering and Founding Director of the Center for Urban Informatics and Progress (CUIP) at the University of Tennessee at Chattanooga. She has conducted research on intelligent transportation, data analysis, and data acquisition for more than 20 years and has expertise in smart city applications. Her expertise includes intelligent mobility, CAV, data curation (data transmission, ingestion, storage, and analysis), computer vision, and predictive modeling. Dr. Sartipi has participated in securing over $14M funding from federal/state/regional government agencies, foundations, and industries in the past few years. These projects cover a variety of applied research related to smart transportation.

Austin Harris is the Testbed Manager for CUIP with expertise in big data, low latency systems,

and systems integration. He has designed and developed a real-time data infrastructure for data collection along the testbed that ingests two billion plus events daily. He is also a Municipal & Industry Partner and coordinates collaboration efforts for the MLK Smart Corridor.

The Vanderbilt University team will be led by Dr. Dan Work, Chancellor Faculty Fellow, Civil and Environmental Engineering, Institute for Software Integrated Systems. Dr. Work pioneered methods for monitoring and controlling road traffic using vehicles, rather than fixed infrastructure, to sense and control road congestion. He and his collaborators were the first to experimentally demonstrate that "phantom" traffic jams, which seemingly occur without an obvious cause but are due to human driving behavior, can be eliminated via control of a small fraction of automated vehicles in the flow. Dr. Work received a 2018 Gilbreth Lectureship from the National Academy of Engineering a 2014 CAREER Award from the National Science Foundation.

Dr. Kamrul Hasan is the Assistant Electrical and Computer Engineering Professor at Tennessee State University. He is researching developing verified, transferrable, and trusted AI/ML-aided models for intelligent transportation systems. Recently, Dr. Hasan secured two grants to build predictive models for road capacity planning and safety-empowered railroad crossing design from the National Science Foundation (NSF) and Federal Highway Administration (FHA), respectively.

Veda Nguyen, PE has worked in both the Engineering Bureau and the Environment and Planning Bureau at TDOT and has gained a breadth of knowledge of the various functions within TDOT. Her main responsibility in the Engineering Bureau was to manage the Intelligent Transportation System Office. The ITS Office is responsible for the planning and design of ITS projects. Her current responsibility in the Environment and Planning Bureau is to manage the Multimodal Planning Office including the Pedestrian Road Safety Initiative (PRSI) program.

APPENDIX I – RESUMES

DIANA ALARCON
Director, NDOT

Years of Experience: 27

Education: Senior Executive Institute (SEI), ICMA, University of Virginia; Environmental Sustainable Management System, IS) 14001, Virginia Tech; BS, Business Administration, University of Florida

Ms. Alarcon is NDOT's Director and has overseen the transformation from a public works department to a high achieving department of transportation with an emphasis on safety, complete streets, and modernization. She has launched Nashville's Vision Zero Implementation Plan, Parking Modernization, and Traffic Management Center. Ms. Alarcon previously served as the Director of Transportation & Mobility for the City of Tucson, AZ and Fort Lauderdale, FL.

Career Highlights:

- ☑ Responsible for a $221.4M budget and over 300 employees
- ☑ Developed the NDOT Vision Zero action plan and five-year implementation plan
- ☑ Partnered with local nonprofits on education initiatives to benefit Metro Nashville Public Schools and region
- ☑ Established the MoveTucson Multimodal Masterplan to weave all modes of transportation through a Complete Street lens
- ☑ First city leader in Florida to adopt a Vision Zero program towards a goal of zero roadway fatalities during her time with the City of Fort Lauderdale

BRAD FREEZE, PE
Chief Engineer, NDOT

Years of Experience: 19

Education: MS, Civil Engineering, University of Tennessee; BS, Civil Engineering, Tennessee Technological University

Registrations: Professional Engineer: TN

Mr. Freeze has served as NDOT's Chief Engineer for the past year following nearly a decade as the Tennessee Department of Transportation's Director of Traffic Operations. He has extensive experience in managing advanced Intelligent Transportation Projects and extensive ties to both the academic and private sector.

Career Highlights:

- ☑ Reorganized the NDOT engineering division to function as a safety-first data forward team
- ☑ Stood up the TDOT Traffic Management Center (TMC) and Traffic Incident Management (TIM) programs
- ☑ Extensive publication history of Intelligent Transportation Systems research
- ☑ Speaks frequently at educational institutions to highlight and encourage careers in the transportation sector
- ☑ Serves as the Technical Advisory Committee Chair for the National Operations Center of Excellence

DEREK HAGERTY, PE
Transportation Engineer, NDOT

Years of Experience: 9

Education: MS, Civil Engineering, University of Tennessee; BS, Civil Engineering, Iowa State University

Registrations: Professional Engineer: TN

Mr. Hagerty leads NDOT's Traffic Management section with a focus on safety and efficiency for all users primarily through the application of technology. He is the day-to-day lead on standing up Nashville's first Traffic Management Center to include detection and performance metrics for all transportation modes.

Career Highlights:

- ☑ Currently managing four ITS grant funded capital projects totaling $14M through the ATCMTD and CMAQ programs
- ☑ Represented Metro Nashville on state DOT safety projects to protect the cities most vulnerable users

VEDA NGUYEN, PE
Civil Engineering Manager 2
Multimodal Division, TDOT

Years of Experience: 15

Education: MS, Civil Engineering, Vanderbilt University; BS, Civil Engineering, Vanderbilt University

Registrations: Professional Engineer: TN

Ms. Nguyen has worked in the Engineering Bureau and the Environment and Planning Bureau and has gained a breadth of knowledge of the various functions within TDOT. Her main responsibility in the Engineering Bureau was to manage the Intelligent Transportation System Office. Her current responsibility in the Environment and Planning Bureau is to manage the Multimodal Planning Office

Project Experience:

- ☑ I-24 Smart Corridor, Phase 1 and 2, TDOT, Nashville, TN
- ☑ Various ITS Expansions along Interstates, TDOT, Tennessee Statewide
- ☑ Various Pedestrian Road Safety Initiative Projects, TDOT, Tennessee Statewide

AUSTIN HARRIS
Testbed Manager, Center for Urban Informatics and Progress (CUIP)

Years of Experience: 7

Education: MS, Computer Science, University of Tennessee at Chattanooga; BS, Computer Science, University of Tennessee at Chattanooga

Mr. Harris is the Testbed Manager for CUIP with expertise in big data, low latency systems and systems integration. He has designed and developed a real-time data infrastructure for data collection along the testbed that ingests two billion plus events daily. He is also a Municipal & Industry Partner and coordinates efforts for the MLK Smart Corridor.

Project Experience:

- ☑ Feasibility of Real-Time Infrastructure-Driven Intervention for Improving Pedestrian Safety, TDOT, TN
- ☑ Emerging Transit Solutions for Underserved Communities, NSF, Nashville, TN
- ☑ Decision Support System for Integrated Transportation and Smart Grid Mgmt, USDOT, Chattanooga, TN

MINA SARTIPI, PhD
Director of the Center for Urban Informatics and Progress, UTC

Years of Experience: 20

Education: PhD, Electrical and Computer Engineering, Georgia Institute of Technology; MS, Electrical and Computer Engineering, Georgia Institute of Technology; BS, Electrical Engineering, Sharif University of Technology

Dr. Sartipi is the Guerry Professor of Computer Science and Engineering and Founding Director of the Center for Urban Informatics and Progress at UTC. She has conducted research on intelligent transportation, data analysis, and data acquisition and has expertise in smart city applications. She has participated in securing $14M funding from federal/state/regional government agencies, foundations, and industries.

Project Experience:

- ☑ Feasibility of Real-Time Infrastructure-Driven Intervention for Improving Pedestrian Safety, TDOT, Chattanooga, TN
- ☑ Harnessing Emerging Transit Solutions for Underserved Communities, NSF, Nashville-Chattanooga, TN

DANIEL WORK, PhD
Professor, Civil & Environmental Engineering, Vanderbilt University

Years of Experience: 12

Education: PhD/MS, Civil and Environmental Engineering, University of California Berkeley; BS, Civil and Environmental Engineering, Ohio State University

Dr. Work is a Chancellor Faculty Fellow and professor at Vanderbilt University. He pioneered methods for monitoring and controlling road traffic using vehicles, rather than fixed infrastructure, to sense and control road congestion. He is a recognized transportation expert whose work has appeared in media outlets including Good Morning America, Reuters, Wired, and MIT Technology Review.

Project Experience:

- ☑ USDOT, I-24 MOTION Test Bed
- ☑ USDOT, ATCMTD Project
- ☑ US Department of Energy, Congestion Impact Reduction via CAV-in-the-loop Lagrangian Energy Smoothing CIRCLES

KAMRUL HASAN, PMP, PhD
Assistant Professor, Electrical and Computer Engineering, TSU

Years of Experience: 6

Education: PhD, Computational Modeling and Simulation Engineering, Old Dominion University; MS, Computer Information and Systems Engineering, TSU; BS, Electrical and Computer Engineering, Bangladesh University of Engineering and Technology

Dr. Hasan is the Assistant Electrical and Computer Engineering Professor at Tennessee State University. He is researching developing verified, transferrable, and trusted AI/ML-aided models for intelligent transportation systems. Recently, Dr. Hasan secured two grants to build predictive models for road capacity planning and safety-empowered railroad crossing design from the NSF and FHA, respectively.

Project Experience:

- ☑ Preparing Minority Scholars for Railroad-Highway Safety Workforce (RH-SAW)
- ☑ Analytically-based Frameworks for AI Model Verification and Improvement in Cyber-physical Systems (AI verification model for transportation traffic Mgmt.)

APPENDIX II – SUMMARY BUDGET NARRATIVE

ARCHITECTURE AND ENGINEERING FEES

$50,000

- 2 In-person meetings facilitated by NDOT staff (printed paper materials and surveys for gathering public feedback, venue fee at minority-owned restaurant serviced by Metro WeGo Bus Route 22)
- 2 virtual public meetings facilitated by NDOT staff
- Workforce development-related tasks of training and assigning activities to students and local community members who will be working in the project area

OTHER ARCHITECTURE AND ENGINEERING FEES

$350,000 - University of Tennessee – Chattanooga

- Senior Personnel (including Dr. Sartipi and her co-faculty) to lead research, planning activities, expertise in smart infrastructure, data analytics, artificial intelligence applied to structural engineering, transportation analysis, intelligent transportation systems, and human factors and safety in transportation to assist the project team with the deployment of the testbed. A 3% increase in has been added to account of an anticipated annual increase in costs of materials and labor
- Other personnel (including students and CUIP Testbed Manager Austin Harris) will be responsible for assisting with algorithm development and data integration, data infrastructure, and coordinating with project team in Nashville on technical aspects of sensor deployment and installation
- Fringe benefits (salaries and health insurance) and travel expenses for UTC staff and students

$175,000 - Tennessee State University

- Senior professors will be responsible for the coordination and integration of students and residents into device installation and data management
- Due to proximity to project location, TSU staff will also facilitate the recruiting of local workforce for training and organized programming of local workforce
- Fringe benefits (salaries and health insurance) and travel expenses for TSU staff and students

$175,000 - Vanderbilt

- Senior research and faculty will assist all project partners in tasks and activities related to the deployment of devices, data analysis, and training classes and workforce development of local community members for their participation in this project
- Fringe benefits (salaries and health insurance) and travel expenses for Vanderbilt staff and students

$200,000 - Design

- Final plans, Systems Engineering Analysis, and NEPA

$620,000 - Construction

- Scoping, building costs, materials, utilities, transportation signals infrastructure integration, and any rollover funds from Design

$430,000 - Equipment

- Sensors and sensor deployment, all technical equipment and supplies, coordination of utilities and all smart infrastructure

APPENDIX III – LETTERS OF COMMITMENT

On the following pages you will find Letters of Commitment from the Nashville Department of Transportation and the Tennessee Department of Transportation.

METROPOLITAN GOVERNMENT OF NASHVILLE AND DAVIDSON COUNTY
JOHN COOPER
MAYOR
NASHVILLE DEPARTMENT OF TRANSPORTATION
AND MULTIMODAL INFRASTRUCTURE

November 18, 2022

Secretary Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC, 20590

Subject: Certification of Financial Contribution 2022 SMART Grant Application: Leveraging Advanced Data to Deliver Multimodal Safety (LADDMS)

Dear Secretary Buttigieg,

The NASHVILLE DEPARTMENT of TRANSPORTATION and Multimodal Infrastructure (NDOT) wishes to express its full support for the Leveraging Advanced Data to Deliver Multimodal Safety (LADDMS) project under the United States Department of Transportation's SMART Discretionary Grant Program. The LADDMS project is a research collaboration effort with NDOT, University of Tennessee (Chattanooga), Vanderbilt University, Tennessee State University, Tennessee Department of Transportation, and other local stakeholders. This project will identify safety incidents outside traditional crash reports, implementing targeted safety measures, and evaluating these measures in Downtown Nashville's complex multimodal environmental under the city's Vision Zero Implementation Plan. This project will benefit the North Nashville area by improving safety for all transportation network users with an emphasis on pedestrians and bicyclists who have been traditionally underrepresented in safety studies.

If awarded, the LADDMS project will install LiDAR and video camera technologies at key intersections and mid-block segments. NDOT plans to collect and evaluate "near-miss" data that would not be identified using traditional evaluation methods, enabling NDOT to further protect our transportation network's most vulnerable individuals. NDOT plans to expand and apply the successful practices to our other neighborhood segments along the High Injury Network (HIN), as NDOT executes the city's Vision Zero Implementation Plan.

Thank you for your consideration of the LADDMS project for the 2022 SMART Discretionary Grant Program. If NDOT can be of any further assistance, please do not hesitate to contact the NDOT Project Manager Derek Hagerty at (615) 862-8645 or via e-mail at Derek.Hagerty@nashville.gov.

Sincerely,

Diana Alarcon
Director, Nashville Department of Transportation and Multimodal Infrastructure

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
COMMISSIONER'S OFFICE
SUITE 700, JAMES K. POLK BUILDING
505 DEADERICK STREET
NASHVILLE, TENNESSEE 37243-1402
(615) 741-2848

BUTCH ELEY
DEPUTY GOVERNOR &
COMMISSIONER OF TRANSPORTATION

BILL LEE
GOVERNOR

November 14, 2022

The Honorable Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

RE: 2022 SMART Grant Application Letter of Support
Leveraging Advanced Data to Deliver Multimodal Safety (LADDMS) – Nashville, TN

Dear Secretary Buttigieg,

I am pleased to provide this letter of support for funding through the United States Department of Transportation's Strengthening Mobility and Revolutionizing Transportation (SMART) Discretionary Grant Program.

The Leveraging Advanced Data to Deliver Multimodal Safety (LADDMS) project is a research collaboration effort with Metro Nashville-Davidson County, the University of Tennessee (Chattanooga), Vanderbilt University, Tennessee State University, the Tennessee Department of Transportation (TDOT), and other local stakeholders. This project, via the use of LiDAR and video camera technologies, will identify safety incidents outside traditional crash reports, implementing targeted safety measures, and evaluating these measures in complex multimodal environments under the City's Vision Zero Implementation Plan.

The location associated with this grant request is in North Nashville which includes Clarksville Pike and Buchanan Street, major westbound-eastbound arterial roadway connections, connecting Northwest Nashville to I-65 in Nashville-Davidson County. This area has high transit ridership and will soon have a new North Transit Center at 26th Avenue North and Clarksville Pike. The area has a high level of pedestrian activity, several pedestrian mid-block crossing areas, and is along a corridor Metro Nashville-Davidson County has designated as a High Injury Network (HIN). This project will benefit the North Nashville area by improving safety to all transportation network users with an emphasis on pedestrians and bicyclists who have been traditionally underrepresented in safety studies.

I am confident that this proposal firmly aligns with the goals of the SMART Grant Program and I thank you for your consideration of Nashville's application.

Sincerely,

Howard H. Eley
Commissioner of Transportation