

Submission Date: July 10, 2025
Lead Recipient/Grant Number: University of Arkansas / 69A3552348331
Principal Investigator Institution: Vanderbilt University
Center Name: Maritime Transportation Research and Education Center
USDOT Research Priority: Preserving the Existing Transportation System
Primary USDOT Strategic Goal (<i>select drop down</i>): Safety
Principal Investigator(s) with ORCID(s) and Contact Information: Dr. Mark Abkowitz (ORCID No. 0000-0002-7278-1008) Distinguished Professor of Civil and Environmental Engineering, PMB 351831, 2301 Vanderbilt Place, Nashville, TN 37235-1831, phone: 615-500-7619, email: mark.abkowitz@vanderbilt.edu ; Co-Principal Investigator: Dr. Ishita Dash (ORCID No. 0000-0003-3308-9163), Research Assistant Professor of Civil and Environmental Engineering, Vanderbilt University School of Engineering, PMB, 351831, 2301 Vanderbilt Place, Nashville, TN 37235-1831; phone: 615-630-9401; email: ishita.dash@vanderbilt.edu
Project Partners: N/A
Project Type (<i>select drop down</i>): Applied Research
Project Research Topic Type (<i>select drop down</i>): Disruption Response and Transportation Planning for Coastal and River Valley Communities
Transportation Modes Involved (<i>check all that apply</i>): ☒ Waterway ☐ Road ☐ Rail ☐ Pipeline ☐ Other
Total Funding Requested (\$): \$150,000 Federal Funding Requested (\$): \$100,000 % of Total for Tech Transfer (%): 5% Non-Federal Match Requested (\$): \$50,000
Project Start and End Dates (Format month/day/year to month/day/year): 10/01/2025 to 09/30/2026
Project Title: Operationalizing Smartwatch Technology to Measure and Mitigate Heat Stress Among Maritime Transportation Workers
Project Abstract (Brief Description): Workers in the maritime transportation industry are being exposed to high-heat and high-humidity conditions, exacerbating their risk of developing heat-related illnesses. They include port and harbor operations, marine cargo handling, navigational services to shipping, and other support activities for water transportation. Heat-related illnesses range in severity from muscle cramps and spasms; to heat exhaustion, which if left untreated, can progress to a more serious condition; to heat stroke, a life-threatening emergency that requires immediate medical attention. Smartwatches have the potential to function as a means for detecting when a heat-related illness is imminent and/or progressing, leading to an opportunity for the risk to be mitigated through intervention. In a current MarTREC project that is nearing completion, the potential for smartwatch heat stress management has been explored by addressing the following research questions: 1) What are key indicators that can be used to quantify heat stress? 2) Can a smartwatch be used to measure heat stress in outdoor working environments? 3) Is it possible to communicate the onset of heat-related illnesses by incorporating a complete closed feedback loop? This project has made considerable progress in examining these questions, which began with conduct of a comprehensive literature review to identify the state-of-the-practice and where research gaps currently exist. These results then informed the development of a conceptual design with the goal of field-testing the application in a small-scale pilot

study. The pilot study demonstrated promising results for the developed technology and its application to be feasibly utilized in an operational environment. The project aims to take this next step, namely to operationalize the technology and application in a maritime setting and to evaluate its effectiveness. More specifically, the goal of the research project is to implement the application for maritime use such that the technology can alert workers and their supervisors in real- time about the onset of heat stress, provide immediate intervention, and contribute to the development of company-wide heat mitigation policy. Ultimately, the proposed project will determine the practicality of deploying smartwatch-based heat stress monitoring systems in this challenging environment.

USDOT Priorities: *Section left blank until USDOT's new priorities and RD&T strategic goals are available in Spring 2026*

Outputs (results of the work performed):

The project will provide a basis for validating the feasibility and transferability of a commercially available technology for detecting and communicating heat stress risk experienced by maritime transportation workers. The research results will also address opportunities for evaluating the effectiveness of risk mitigation strategies to better manage this threat.

Outcomes/Impacts: This achievement will fill a substantial knowledge gap associated with high temperature risk at both the technical and practitioner level. Importantly, the work will provide proof-of-concept of a technology application with the potential for widespread adoption by maritime transportation and other industry sectors.

Technology Transfer Activities: Knowledge transfer will be pursued, including presentations of project results at major conferences (e.g., TRB annual meeting, Society of Risk Analysis, etc.) and publication in peer-reviewed journals. Vanderbilt will also seek to disseminate results to and obtain feedback from stakeholders via its connections with public and private sector entities.

Final Research Report: Upon completion of the project, provide a URL link to final report will be provided

Project Deliverables: ☒ PI agrees to submit all deliverables within 4 weeks after the project end date.

Data Management Plan (DMP): ☒ PI has reviewed and agrees to adhere to MarTREC DMP. Proposed project DMP must be attached to the submission email along with this form.

USDOT Approval Date: 11/06/25