Non-Motorist Safety at Highway-Rail Grade Crossings: Developing a Crash Prediction Model with Integrated Non-Motorist Exposure

Deliverables and Reporting Requirements for UTC Grants Awarded in 2023 (June 2023)

Exhibit D

Recipient/Grant (Contract) Number: University of Texas Rio Grande Valley (UTRGV)/Grant No. 69A3552348340

Center Name: University Transportation Center for Railway Safety (UTCRS)

Research Priority: Promoting Safety

Principal Investigator(s): Aemal Khattak (PI, University of Nebraska-Lincoln (UNL)), M. Naveed Aman (Co-PI, UNL), and M. Umer Farooq (Co-PI, UNL)

Project Partners: N/A

Research Project Funding: $147,500 (Federal), $71,836 (Non-Federal Cost Share)

Project Start and End Date: 06/01/2024 to 08/31/2025

Project Description: Non-motorist users at highway-rail grade crossings (HRGCs) include pedestrians, bicyclists, wheelchair users, skateboarders, and push scooter users, among others. Incidents involving non-motorist users at HRGCs are often underreported or overlooked, yet statistics reveal that they significantly contribute to overall fatalities and injuries at these locations. Pedestrians and bicyclists are particularly vulnerable at HRGCs due to the lack of adequate protective barriers or warning devices. In 2022, the Federal Railroad Administration (FRA) recorded 2,202 crashes at HRGCs, leading to 269 fatalities and 827 injuries nationwide. Furthermore, during the same year, there were 1,157 reported incidents of pedestrian rail trespassing, resulting in 606 fatalities and 551 injuries. These numbers emphasize the need for a comprehensive understanding of the risks associated with non-motorized users at HRGCs and identification of crossings where non-motorized users may be susceptible to crashes.

In 2020, the Federal Railroad Administration (FRA) developed a crash frequency model for HRGCs; however, it does not consider non-motorist characteristics in its crash prediction. It is anticipated that adding components pertaining to pedestrians, bicyclists and other non-motorist users will improve the model's overall crash prediction. This improvement has the potential to guide more efficient resource allocation and HRGC's safety decision-making. Furthermore, the existing FRA model relies on conventional statistical analyses. In contrast, our proposed research aims to explore the efficacy of robust artificial intelligence (AI) based models for crash prediction at HRGCs. We seek to compare traditional statistical prediction models with AI-based models for crash predictions at HRGCs; the investigation aims to discern the superior performance of these models by evaluating their precision and fitness according to established criteria. These models will not only encompass physical characteristics of HRGCs grade crossings but would also integrate dynamic elements such as train and vehicular traffic, along with non-motorist exposure and its associated factors. The non-motorist exposure data will be acquired upon the successful completion of Phase I within our broader research framework.

Anticipated outcomes of this study include improved HRGCs' crash frequency prediction model. This research will contribute to a deeper understanding of safety hazards associated with HRGCs, considering various dynamic attributes related to traffic and trains, acknowledging the vulnerability of non-motorists at HRGCs. The proposed model would be developed through a comprehensive approach, incorporating policy perspectives on grade crossing safety, thorough data reviews, statistical analyses, AI-based techniques, and rigorous validation processes. Ultimately, the research findings are expected to empower transportation agencies to implement proactive safety measures, assisting in reducing the frequency of crashes and promoting the overall well-being of both motorized and non-motorized HRGCs users.

US DOT Priorities: The proposed research is directly related to the USDOT strategic goal of making the transportation system safer for all people and to advance a future without transportation-related serious injuries and fatalities. The primary focus on developing a new crash prediction model that encompasses all types of traffic at HRGCs is instrumental for optimizing resource allocation effectively. The inclusion of non-motorized crash exposure factors in the HRGCs crash prediction model can improve decisions related to non-motorists' infrastructure improvements, signal timings, automated technologies, warning systems, and enforcement strategies. The outcomes of this research are anticipated to play a pivotal role in shaping safer transportation ecosystems. The incorporation of pedestrian and bicyclist safety considerations within the rail industry signifies a proactive approach towards creating a more inclusive and secure transportation landscape.

Outputs: The research team will develop a new crash prediction model for HRGCs that will incorporate all types of motorized and non-motorized traffic. This model will offer valuable insights and guidance for enhancing the safety of various railroad grade crossing users, including drivers, train operators, pedestrians, and bicyclists, across the United States. The project will yield specific deliverables, including:

1. A database detailing the exposure of vehicles, pedestrians and bicyclists at HRGCs.
2. A final representative model based on the comparison of statistical and AI crash prediction models.
3. Recommendations for future studies and a comprehensive project final report, consolidating findings and insights to contribute to the improvement of safety measures at HRGCs nationwide.
4. Publications in industry publications and presentations at professional conferences.

Outcomes/Impacts: The proposed research is transformational in nature and its broader impacts include the potential for precise HRGCs crash prediction that will extend guidance on correct decision-making processes for HRGCs resource allocation and implementation of effective risk remedial measures.

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