Smart Transportation Planning and Management for High-Impact Events Integrating Digital Twin and Computer Vision Technologies

Organizing high-impact events, such as sports tournaments, festivals, and concerts, poses significant social, economic, and transportation challenges. These events can heavily strain transportation infrastructure, security protocols, and public services, especially in already congested and economically vital areas like the New Jersey-New York region, which draws large, diverse crowds from across state lines and around the world. In alignment with U.S. Department of Transportation's priority of Advanced Technology Innovation and Transformation, this research is a partnership with the New Jersey Sports and Exposition Authority (NJSEA), the Meadowlands Sports Complex, and industry partner AIWaysion. The project is leveraging the preparation and planning process for major events as a case study to develop and enhance smart transportation strategies for managing high-impact events at the Sports Complex.

The project aims to develop AI-driven deep learning computer vision tools integrated with Digital Twin technology to enhance crowd detection (e.g., identifying clusters of visitor foot traffic) and improve traffic management, such as ridesharing coordination and emergency response optimization. Additionally, the project is piloting smart cameras equipped with Edge AI computing capabilities (i.e., process data locally on devices), enabling faster and more efficient data processing at the source. These systems are being designed for both planning purposes and real-time operations, featuring predictive capabilities to identify risks associated with disruptions.

Project Scope
- **Stakeholder Engagement:** Engage with stakeholders through multiple discussions to understand their specific needs and collaboratively prioritize use cases.
- **Literature Review:** Analyze recent advancements in event transportation management, focusing on intelligent transportation systems and traffic demand management for high-impact events.
- **Smart Camera Pilots and AI Development:** Deploy smart cameras with Edge AI computing capabilities and develop AI-based computer vision tools for vehicle and foot traffic detection using both existing and newly installed cameras.
- **Traffic Digital Twin Prototype:** Create a Traffic Digital Twin integrated with event management systems to assist analyzing traffic conditions before and after events. This digital twin will incorporate data from cameras and third-party sources, such as Waze.
- **Real-World Pilot and Evaluation:** Implement and evaluate selected use cases, such as foot traffic monitoring and ridesharing coordination, based on stakeholder feedback to ensure practical and effective solutions.

Expected Outputs/Outcomes

- An AI-powered computer vision methodology for crowd and traffic detection to enhance real-time traffic operations, offering insights on optimizing resource allocation before and after high-impact events.
- A digitally-powered solution - a Digital Twin web-based tool to support efficient management of high-impact events through integrated data visualization and predictive modeling.
- Validate the feasibility and effectiveness of Edge-AI cameras for real-time event monitoring and traffic management.
- Centered on a stadium with cross-region bi-state and international attendees, this research will also generate insights to drive future innovations in smart event transportation management and offer valuable strategies for addressing man-made, event-induced traffic in complex urban environments.