Request for Research Funding for FY 2024-2025			
Project Number (Research Center Use Only): OET-25-05			
Requesting Office	Central Office Emerging Technologies	**Priority**	5 of 8
Proposed Title	Utilizing Digital Twining Technologies for Addressing FDOT Priorities		
Justification	Digital twins are at the forefront of today's technological advancements and provide a novel approach to complex and interrelated environments. Digital Twins offer innovative approaches to efficiently plan, manage, operate, and optimize the highly complex and constantly evolving transportation ecosystem, enabling accelerated understanding of success and/or impact of projects prior to their actual deployment. The project will advance the FDOT Compass with the follow three objectives: (1) establish a comprehensive understanding of Digital Twin technology in the context of transportation. This involves providing an overview, conducting a thorough literature review, and exploring practical use cases that create a foundation for further applications; (2) developing a prototype Digital Twin framework tailored to the specific needs of the FDOT. This involves addressing technical considerations such as data integration, interoperability, and scalability to lay the groundwork for practical implementation; (3) demonstrating the practical applications of Digital Twin technology in transportation as well as utilizing the SunTrax testing facility as a real-world testing ground. This involves simulating scenarios, integrating diverse data sources, and showcasing the potential of Digital Twin technology in enhancing decision-making, safety, and infrastructure planning.		
Impact	This proposal represents a significant step forward in leveraging cutting-edge technology for efficient planning and management. The project's three objectives, including establishing a comprehensive understanding of Digital Twin technology, developing a tailored prototype for FDOT, and demonstrating practical applications at the SunTrax testing facility, collectively aim to enhance decision-making, safety, and infrastructure planning in the transportation sector. If successful, this initiative could revolutionize how transportation ecosystems are planned and managed, offering accelerated insights into project success and potential impacts before actual deployment.		
Affected Offices/ Districts	Emerging Technologies		
Existing Work	UCF and FDOT has been at the forefront to test Digital Twin applications in the context of transportation safety and mobility. Few applications include: • Using Connected Intelligent Transportation to Enhance Vulnerable Road User Safety • How Does a Digital Twin Network Work Well for Connected and Automated Vehicles: Joint Perception, Planning, and Control; • An AI-reinforced Traffic Digital Twin for Testing Emergency Vehicle Interventions; • A Parallel Intelligence-Driven Resource Scheduling Scheme for Digital Twins-Based Intelligent Vehicular Systems; • Towards Next Generation of Pedestrian and Connected Vehicle In-the-Loop Research: A Digital Twin Co-Simulation Framework; • Infrastructure-Based Digital Twins for Cooperative, Connected, Automated Driving and Smart Road Services.		
Keywords Used In Existing Work Search **(Cannot leave blank)**	Digital Twin, transportation, autonomous vehicle, sensors		
Related Contracts (Give contract numbers)	N/A		
Funding Request	$50K	**Anticipated Duration**	6 months

Project Manager	Raj Ponnaluri	**Contracting Method**	Direct contract with University of Central Florida
Equipment	$5000	designing accurate 3D basemap, software and materials	
Urgency	1	Pedestrian safety is a statewide concern. Many cases of pedestrian-vehicle conflicts and crashes can be prevented if studied under Digital Twin. It is expected to provide valuable insight for DOTs to plan mitigate such conflicts and crashes.	
Implementability	1	The proposed work is implementable using a driving simulator and a pedestrian simulator.	

Project Benefits (Succinct, complete explanation)

This project will offer a comprehensive exploration of the Digital Twin concept and applications in transportation that will potentially advance FDOT Compass. Few benefits are highlighted below:

- The project's focus on deploying roadside sensors within the Digital Twin environment prior to SunTrax testing allows for swift measurement of performance metrics. This capability enables quick assessments and before-and-after evaluations resembling field studies, providing valuable insights for optimizing transportation systems efficiently.
- The simulation of digital twin sensors not only aids in optimizing their placement but also facilitates analysis of coverage. This optimization is crucial for resource efficiency and cost-effectiveness, ensuring that the deployment of sensors and other infrastructure components is strategically planned to achieve maximum impact.
- The study of vehicle-pedestrian applications involves creating a digital replica of real-world traffic participants within the Digital Twin environment. This approach ensures the safe implementation and testing of vehicle-pedestrian applications, reducing potential risks and enhancing the overall safety of transportation systems.
- The project's exploration of additional use cases for SunTrax testing highlights its commitment to continuous improvement and innovation. By identifying and leveraging diverse applications for Digital Twins in the testing environment, the FDOT can unlock new opportunities for enhancing transportation infrastructure and operations.

Project Benefits **(Select all that apply and explain)**	**Quantifiable Benefits (units, dollars, etc…if applicable)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhancement		
o Financial Impact	Reduced need for traditional field testing of the sensors	The financial costs associated with field testing of sensors can be waived to a great extent using Digital Twin.
o Time Savings	Reducing the sensor field implementation time at least 2 hours per testing day. The autonomous vehicle testing time will be saved by days per testing if run in a digital twin environment.	The research is anticipated to generate a time savings by significantly reducing the need for traditional field testing in transportation, leading to cost savings associated with resource allocation, testing logistics, and project timelines.
o Lives Saved/Injuries Prevented	Lives and Injuries	Pedestrian-vehicle conflicts can be extensively studied in a virtual world. It is possible to test situations previously impossible like near misses and even actual crashes. The insights from the testing will be impactful for saving lives and reducing injuries.
o Other (Explain)		

*Comments should explain and support urgency, financial benefit, and implementability scores