A Bridge Digital Twin for Enhancing Transportation Resilience and Asset Management

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21STLSU08

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Lead Institution:

Louisiana State University

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Tran-SET

Louisiana State University

Total Project Cost:

$ 60,000

Developing a bridge digital twin for enhancing asset management

As the Region 6's transportation network exponentially grows, each DOT requires seamless collaboration of relevant stakeholders with bridge infrastructure construction and maintenance data organized in an integrated, safe, trusted, and interoperable manner. Since bridges encompass several vulnerable components, they should be carefully managed, maintained, and monitored by DOTs in each state. The Federal Highway Administration (FHWA), according to Federal-Aid Highway Act of 1968, requires all states to perform a biennial inspection for each bridge to document its condition for maintaining, repairing, and rehabilitating bridges. The Louisiana Department of Transportation & Development (LaDOTD) performs inspections on nearly 13,000 bridges at least every two years including 16,387,706 square feet of bridge deck, which ranks 4th in total bridge area in a nation. However, state DOTs have separately stored and managed the data of numerous bridges as engineering design/drawing information, asset maintenance data, and field inspection data. The primary issue is that these data and database are not consistently connected and linked. The primary objective of this proposed project is to explore and develop a digital twin prototype for bridge management. Bridge Information Modeling (BrIM) is the specialization of BIM to bridge projects, but its use in transportation infrastructure is severely limited due to the lack of standardization.

Problem Statement

Even though the bridge management system (BMS), which helps manage bridge design, construction, and maintenance data, has been widely used in DOTs, the systems of Region 6 DOTs have heterogeneous bridge data formats and information structures that prevent seamless collaboration and data sharing, providing the insufficient capability to fully integrate and exchange bridge asset and maintenance data. This challenge has been caused by the lack of integrated digital systems for integrating all bridge facility management data. To address the large practical knowledge gap in managing bridge facility and asset data, 23 state DOTs in U.S. have just launched the Pooled Fund Bridge Project named "Building Information Modeling (BIM) for Bridges and Structures" to develop a robust and integrated bridge design and construction information standard. The participation of Region 6 States in this project is not planned, and thus it is one of critical priorities for Region 6 States to investigate their current practice of bridge asset management systems and explore an advanced approach fully integrated with digital asset management techniques to enhance bridge construction, maintenance, and inspection processes.

Objectives

The main objective of this proposed project is to explore and develop a digital twin prototype for bridge management. In this project, the PIs will build a digital twin platform that can includes BriM models and explore possible benefits for bridge asset management. The environment combines a 3D representation of one small bridge and helps data integration of bridge inspection and management information. Furthermore, this project will include the investigation of possible strategies for advanced bridge asset management and maintenance processes with the proposed technology.

Intended Implementation of Research

This project will provide a means for Louisiana and Texas to facilitate the systematic bridge asset management processes by providing a digital twin-based approach.

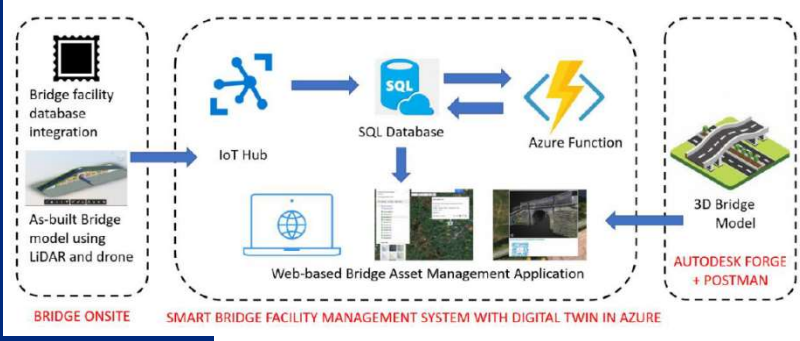

Figure 1. Project Overview and Planed Tasks

Anticipated Impacts/Benefits of Implementation

Practitioners in DOTs can use to store and integrate diverse bridge asset and inspection data by adopting a bridge digital twin technology and make a well-guided decision on the integrated bridge asset and maintenance processes.

Web links

- Tran-SET's website https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.