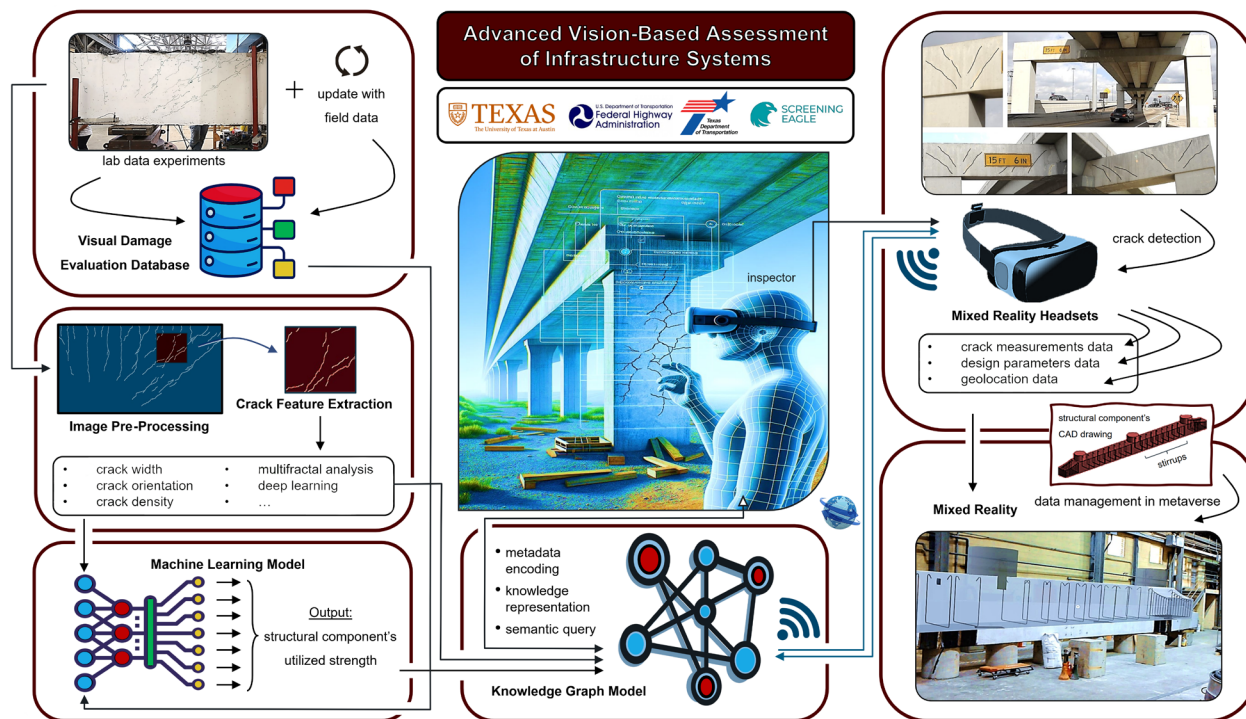




EMPLOYING ARTIFICIAL INTELLIGENCE (AI) TO ENHANCE INFRASTRUCTURE INSPECTIONS

July 2024

Assessing reinforced concrete structures for cracking, crack widths, patterns, and orientations usually involves some form of visual inspection. The Advanced Vision-Based Assessment of Infrastructure Systems project is developing technologies to help with visual bridge component inspection. These technologies will automatically and quantitatively assess transportation infrastructure maintenance needs in realtime.



Source: FHWA.

With support from the Federal Highway Administration's (FHWA) Exploratory Advanced Research (EAR) Program, a team of researchers at the University of Texas at Austin is creating this new visual inspection system that uses a pair of virtual reality (VR) goggles to overlay what the human eye sees when surveying bridge components for maintenance needs. Similar mixed-reality systems already exist in the military and medical fields.⁽¹⁾

A computational tool that incorporates machine learning will also perform structural diagnostics decisionmaking for the system. This AI-enhanced decisionmaking will provide the inspector

wearing the VR goggles with information (e.g., crack lengths, crack widths, patterns, and orientations) represented by virtual images in the inspector's field of sight. The computational tool will be able to organize data captured from multiple sources and determine relationships between elements of those data.

METHODOLOGY

The research team will complete the following five tasks for this project:

1. Establish technical goals for the project at a kickoff meeting and decide on performance specifications for the new technology.





EMPLOYING ARTIFICIAL INTELLIGENCE (AI) TO ENHANCE INFRASTRUCTURE INSPECTIONS

July 2024

- Investigate the relationships between visual signs of damage, structural details, and loading conditions. The team will also create a visual damage evaluation database and use that database to design, train, and validate the AI-driven decisionmaking tool.
- Create a new decisionmaking computational tool.
- Create the mixed-reality device.
- Make use of structural testing programs at the University of Texas at Austin to validate the efficacy of their proposed methodology using previously tested structural components.

RESULTS

To document its research and findings, the research team will:

- Produce a detailed technical report for FHWA.
- Provide guidelines for adopting the bridge component inspection technologies developed.
- Create an open-source software program that makes knowledge graphs and can also act as a core component of other software programs.
- Create a mixed-reality platform for structural health monitoring.
- Prepare peer-reviewed journal articles, presentations at national and international conferences, and dissertation defenses.

Once completed, these products will be given to FHWA.

FHWA-HRT-24-055
HRTM-30/07-24(WEB)E

Notice: This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

Non-Binding Contents: Except for the statutes and regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the States or the public in any way. This document is intended only to provide information regarding existing requirements under the law or agency policies. **Quality Assurance Statement:** The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement. **Disclaimer for Product Names and Manufacturers:** The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this document only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

What Is the EAR Program?

The EAR Program supports longer term, higher risk research with the potential for transformative improvements to the U.S. transportation system. The EAR Program seeks to leverage promising expertise and advances in science and engineering to create breakthrough solutions to highway transportation issues.

REFERENCES

¹Stanney K, J. Archer, A. Skinner, et al. 2022. "Performance Gains From Adaptive eXtended Reality Training Fueled By Artificial Intelligence." *The Journal of Defense Modeling and Simulation* 19, no. 2: 195–218.

CONTACT

For more information about this EAR Program project, please contact Robert Zobel, FHWA Office of Infrastructure Research and Development, at 202-493-3024 (email: robert.zobel@dot.gov).

LEARN MORE

To learn more about the EAR Program, visit <https://highways.dot.gov/research/exploratory-advanced-research>. The website features information on research solicitations, updates on ongoing research, links to published materials, summaries of past EAR Program events, and details on upcoming events.

Recommended citation: Federal Highway Administration, *Employing Artificial Intelligence (AI) to Enhance Infrastructure Inspections* (Washington, DC: 2024) <https://doi.org/10.21949/1521489>



U.S. Department of Transportation
Federal Highway Administration