Bridge Cracks Monitoring: Detection, Measurement, and Comparison using Augmented Reality

Developing a method for using augmented reality technology to monitor bridge cracks

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Total Project Cost:

$120,000

It is necessary to ensure appropriate and efficient functioning of infrastructure. Infrastructure systems in the US, including transportation networks and their subsystems, such as railroad systems and bridges, are subject to rising demand due to higher transportation loads. Furthermore, the infrastructure components deteriorate due to natural processes such as aging and the gradual weakening from excessive use. It is thought that the deterioration may be expedited by climate change, which may in turn lead to more frequent sudden environmental catastrophes, such as hurricanes and flooding. These events seriously impact the infrastructure serviceability and may affect both its safety and capacity. The problem of infrastructure deterioration, in particular the decay of bridges, has been noted by the State Departments of Transportation. The overall score of bridge decay was D+ on the 2017 infrastructure report card, which has led the State Department of Transportation in New Mexico to take steps to prevent further deterioration. Given the finite funds that can be given for bridge repair and maintenance, the most feasible method to control infrastructure decay is to perform frequent, meticulous, and impartial inspections. With this, inspectors can determine the condition and serviceability of bridges and then inform the infrastructure managers about their results. Once routine inspections are performed, infrastructure managers can compare their results and detect changes in the bridge condition. Consequently, infrastructure managers can prioritize bridge management plans to pay closer attention to bridges and other elements of infrastructure that display more decay. Therefore, it is critical to perform detailed, routine bridge inspections, as they play a major role in determining the condition and urgency of repair of the inventory of bridges New Mexico.

Problem Statement

Accurate and reliable data collection by bridge inspectors remains a challenge. Some of the main challenges include the following:

(1) the insufficient amount of information that can be collected during the limited inspection time

(2) the variability of the data that is collected in between inspections, as even the same inspector may introduce some changes in between inspections in different years

(3) the access and assimilation of past inspections while conducting the inspection at the bridge

Objectives

The New Mexico Department of Transportation (NMDOT) expressed the need for a study that will provide a research solution, in a disciplined manner, to enable bridge inspectors to

(1) collect objective data in the field faster

(2) save bridge data that can be compared across time or across inspectors

(3) make it possible to share the data from past inspections with other inspectors, so that they can better understand changes in the field, which may evidence of infrastructure decay. This project investigates possible ways to implement updated camera technologies and AR tools to fulfill the needs expressed by NMDOT. Specifically, it proposes to use a new Microsoft 3D camera, along with other cameras, to explore the potential of a real-time crack sensing. Moreover, it will apply augmented reality headsets such as HoloLens from Microsoft, which can enhance the amount of information that can received by inspectors during crack detection.

Intended Implementation of Research

Education and Workforce Development: The involvement of high school students, undergraduate students, inspectors, and infrastructure owners will enable the preparation of students and existing inspectors in augmented reality technologies while developing them and testing their operations. This project will develop STEM courses in augmented reality for undergraduate students that will be taught by doctoral students. This research project will also guide inspectors in augmented reality technologies to assess existing infrastructure.

Outreach: The participation of many transportation experts in the review panel will ensure considerable outreach. This research project will also be presented during Engineering 9 Open House activities, high school meetings, and other community events like STEM and STEAMH that introduce students to the urgency of transportation engineering.

Figure 1: Field test of Augmented Reality Training

Anticipated Impacts/Benefits of Implementation

The main deliverables from this study are:

(1) Benchmarking results of using the mentioned software with conventional inspections (field implementation). This will lead to the creation of a template with an AR crack inspection specification procedure, to be used by NMDOT

(2) A final report containing the problem, procedures, data, and recommendations.

(3) Presentations to be given at annual, international conferences.

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.