RESEARCH ADMINISTRATION
Bureau of Field Services
Michigan Department of Transportation

Research Spotlight

New 3-D app speeds bridge inspection

MDOT has been exploring how tablet computers, smartphones and wireless data systems can make bridge inspection safer and more efficient. Researchers developed an application that inspectors can use in the field to record location-specific observations on a 3-D model of a bridge using a mobile device. Inspectors can mark deterioration on the 3D BRIDGE app as they inspect bridge elements, and the app will automatically upload inspection results to MDOT's bridge management database.

MDOT's new 3D BRIDGE app for mobile phones and tablets (inset) allows bridge inspectors to record precise observations on a 3-D model of the bridge during inspection.

Problem

Traditionally, MDOT's bridge inspectors have recorded their observations on paper in the field and then entered them into the Bridge Management System (BMS) database when they returned to the office. Faced with an aging bridge inventory and increased federal requirements for collecting element-level data on individual bridge components, MDOT has begun using tablet computers to increase the efficiency of collecting bridge condition data, but software had not yet been developed to allow inspectors to easily integrate the location-specific data recorded on these tools into the BMS.

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Project Information

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"This software not only allows inspections to be done in a more mobile-friendly way, but also advances the state of the art in bridge inspection to add 3-D locations to our bridge inspection findings."

Rebecca Curtis, P.E.
Bridge Management Engineer

Research

MDOT worked with Michigan Technological University and its Ann Arbor-based research center, the Michigan Tech Research Institute, to develop and demonstrate a bridge inspection application that will interface with the BMS to create and use 3-D models of the state's bridges. The app will allow inspectors to record defects and element-level data at specific locations on the models and upload the inspection data to the BMS.

To design the app, researchers reviewed literature on the use of mobile technologies in bridge inspection to identify software and hardware options. The team interviewed MDOT bridge inspectors to learn what their needs are and determine how to meet them with flexible, user-friendly, field-friendly inspection software.

Investigators reviewed BMS capabilities and developed a server application that draws element-level bridge component data from the management databases. Using a gaming platform – Unreal Engine – the team created software that uses the BMS data to build 3-D models that can be used on tablets in the field. The team developed navigational tools and data entry functions that create location points and areas on models and attach data to them. The 3D BRIDGE app was tested with MDOT bridge inspectors in the field to ensure that it met their needs.

Next, the researchers developed a function for transmitting field data to the BMS. The team also worked on data analysis tools, including a summary view for analyzing defect data in element-level and National Bridge Inventory (NBI)-level formats that meet federal standards. Finally, the team prepared a user manual for the application.

Results

The 3D BRIDGE app provides a crucial link between inspectors' tablet computers and the BMS database. The app uses BMS data to create 3-D bridge models, and if there is not enough data to create a sufficiently representative 3-D model, the result can be modified by the user. Drop-down menus and navigation tools allow inspectors to traverse entire elements and select specific points on model surfaces to attach data, photographs and comments. Inspectors can mark the location of defects and display color codes to indicate their severity.

The app can be used offline as well. Models and data can be downloaded to the tablet before inspection, if needed. The app periodically saves and stores data; if a wireless signal is lost during inspection, the data is preserved offline until it can be uploaded to a cloud-based format that integrates with the BMS. Within the app, summary views in NBI and element-level formats allow engineers to review and analyze defect information to help identify repair and reconstruction needs and plan maintenance accordingly.

Value

The 3D BRIDGE app has the potential to significantly improve the efficiency of bridge inspections at MDOT. By uploading inspection data directly into the BMS database, the app will minimize data entry time, improve accuracy and allow inspectors to focus on gathering the detailed element-level data required by federal regulations. In addition, by enabling the recording of location-specific information on defects and distresses, the app can help improve deterioration modeling used in bridge asset management.

A follow-up project has begun to implement the app throughout MDOT's bridge management and maintenance programs, positioning Michigan as a leader in using 3-D models for recording location-specific bridge inspection data in the field. The research team is continuing to work with MDOT users to increase the range of bridges modeled and add features like bridge skew, expanding the app's usefulness for more complex bridges in the MDOT system.

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