JOINT TRANSPORTATION RESEARCH PROGRAM

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Development and Verification of Web-based Bridge Monitoring Interface

Introduction

Off-the-shelf data acquisition systems have advanced over recent years, becoming readily available, reasonably priced, and more user-friendly. High-speed wireless cellular networks have also been established, offering the potential for remote monitoring as never before. The bridge engineering industry generally accepts the need for long-term monitoring of scour and general structural response of bridges. However, short-term monitoring using quickly deployable, rugged systems is also desirable in cases where impact, fire, environmental effects, or other damage may occur to valued infrastructure. These monitoring systems, coupled with a web-based, real-time data display, can become very effective asset management tools for bridge owners.

The Virginia Avenue Bridge near Indianapolis, Indiana, was selected as the case study to exercise and verify a prototype web-based bridge monitoring system. The superstructure of this bridge is often impact loaded by truck cargo due to its 14-ft. underclearance. Thus,

the prototype system was targeted specifically to monitor and alert key personnel of any impacts. Additionally, the monitoring system automatically captured and delivered high definition video footage of the impact event. The prototype was developed with autonomy in mind, requiring minimal supervision, providing versatile capability, enduring severe environmental conditions, and having remote connectivity.

Findings

- Real-time, web-based bridge monitoring systems can be developed using readily-available, off-the-shelf resources. The prototype developed during this project was primarily made up of commercially available components from Campbell Scientific, Inc., Logan, Utah.
- Software based on graphical user interfacing is available providing drag-and-drop methods of creating web-based data displays. This software even enables users who are not trained in website de-

Still image taken from HD video footage of a car atop a tractor trailer impacting the Virginia Avenue Bridge.

Still image taken from HD video footage of a truck cab impacting the Virginia Avenue Bridge.

velopment to create data-rich, effective monitoring displays that can be run from a PC or published to a web server.

- Existing technology, such as wireless cellular service and host email servers, provide effective and reliable platforms to base real-time notification protocols on. Three protocols were developed under this project, including email messaging from the datalogger, text messaging from the datalogger, and email messaging with attachments from the digital camera. Using established technology and methods of wireless communication simplifies implementation and minimizes life cycle costs of the system.

Implementation

Bridge girder impact captured on video footage was the targeted bridge parameter for the prototype monitoring system. However, it should be emphasized that the major components of the prototype system could be adapted for implementation on a variety of bridges, in different and even more remote locations, monitoring

entirely diverse parameters of interest (e.g. overload, load distribution, fatigue, pier tilt, temperature, etc.). Furthermore, the web-based user interface can be configured to receive real-time data from a network of dataloggers stationed at different locations throughout the State or Nation. Thus, a single user interface can be made to concurrently display a multitude of data from a number of bridges.

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Web-based interface providing the user with immediate understanding of onsite conditions and status of the monitoring system.